Volume 25 JANUARY, 1919 Number 5

Engineering Library GENERAL LIBRARY JAN-6 1919 UNIV. OF MICH.

MACHINERY

THE INDUSTRIAL PRESS, Publishers, 140-148 LAFAYETTE ST., NEW YORK

A Bright Year Dawns

For four years—darkness! And now the blessed sunshine!

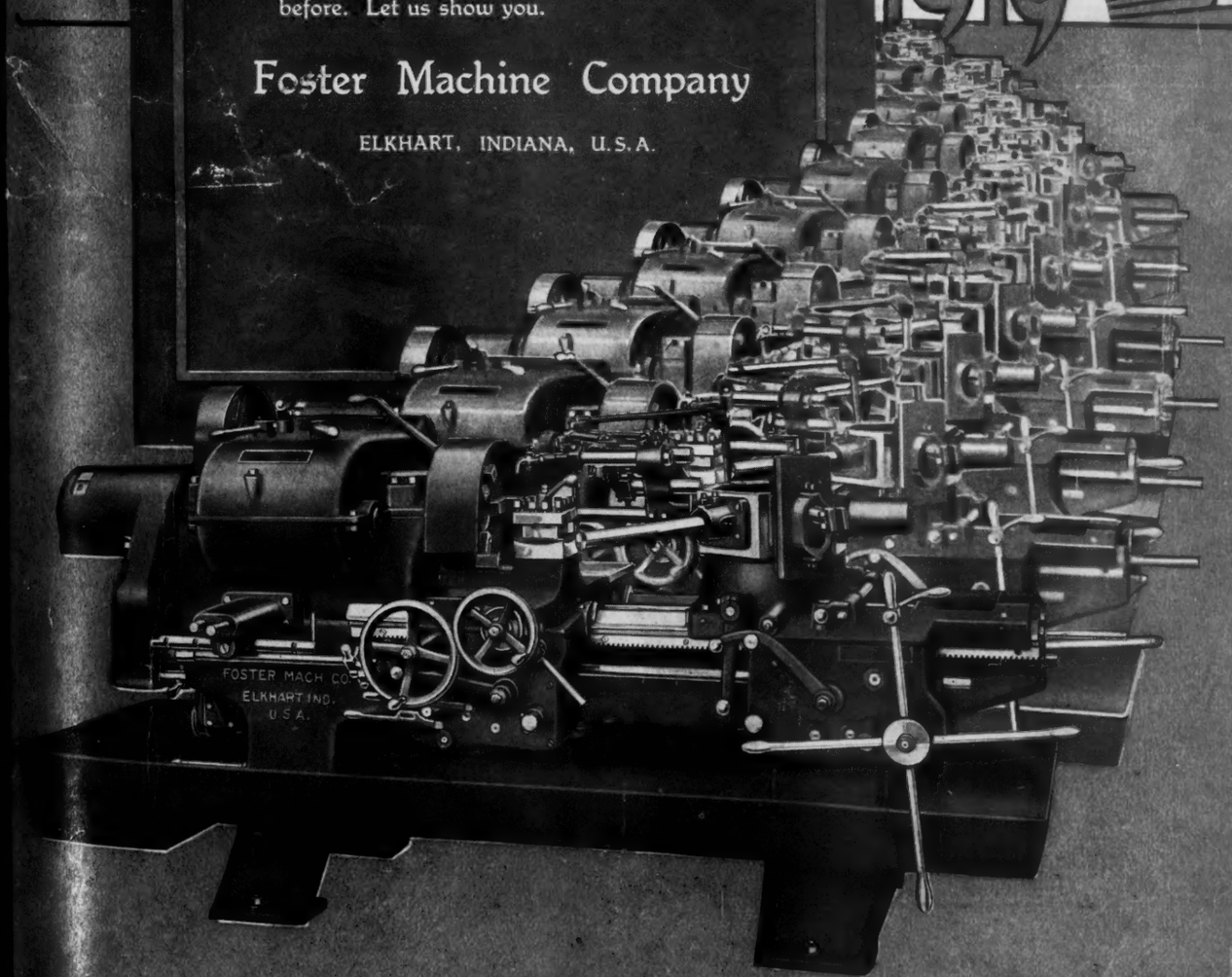
The day has its problems however. Pre-war methods won't do. War time extravagances can't continue. In anticipation of this day we have devoted our energies to the development of Foster Universal Turret Lathes. They are our contribution. We're proud of them.

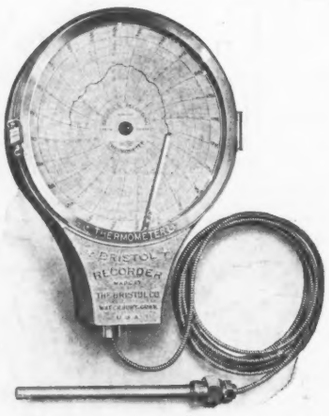
Several sizes, to do certain work better and cheaper than it has ever been done before. Let us show you.

Foster Machine Company

ELKHART, INDIANA, U.S.A.

1919





No Expert Attention Required

to install or keep in perfect working condition

TRADE MARK
BRISTOL'S
REG. U. S. PAT. OFFICE

Recording Instruments

THE design is so simple that no experience is necessary to mount and connect any Bristol's Instrument ready for use.

Keeping the pen filled and renewing the charts every day is practically all the attention they require to keep them in continuous service.

That's why so many Bristol's Instruments are now in service for years without repairs.

Their application for recording variations in pressure, temperature, water levels, speed, time, electricity and motion covers the widest range.

Write for Bulletin 204-E

THE BRISTOL CO., Waterbury, Conn.

Branch Offices: **Boston, New York, Pittsburgh, Chicago, San Francisco**

SPECIAL NOTICE TO USERS OF OXYGEN

THE requirements for Government work make it imperative that every Linde cylinder be emptied and returned immediately.

Orders should be issued to everyone in your employ having to do with cylinders, emphasizing the importance of this.

Oxygen deliveries under present conditions will be largely regulated by the rapidity with which cylinders are emptied and returned.

THE LINDE AIR PRODUCTS CO.

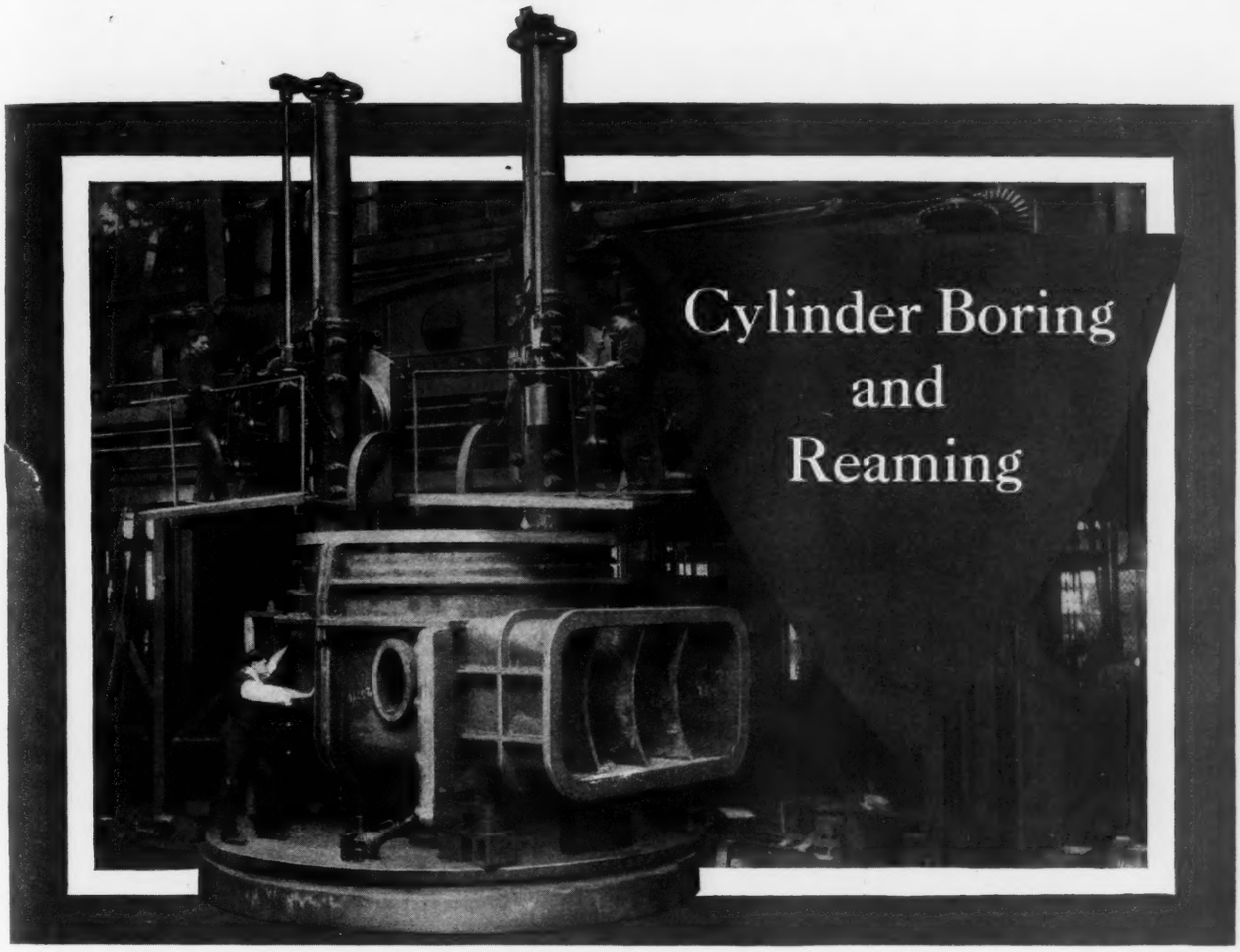
The Largest Producers of Oxygen in the World

42nd STREET BUILDING

NEW YORK

305

JANUARY MACHINERY 1919



First of a Series of Articles Dealing with the Boring, Reaming and Grinding of Cylinders, and the Tools, Fixtures and Machines Used

BY FRANKLIN D. JONES

In the making of steam engines, and more especially in the manufacture of gasoline engines, or other motors of the internal combustion type, the finishing of the interior surfaces or bores of the cylinders is an important operation. A true cylinder is essential in a steam engine, but it is even more vital in an oil or gas engine, because of the close relation between the proper degree of compression and the power developed by the motor. This is the first of a series of articles dealing with the different methods, tools, fixtures and machines used for cylinder work. As the most highly developed cylinder machining methods are found in automobile plants, the equipment and practice of these plants is a special feature of these articles. In factories producing motors by the thousand, it has been necessary to do the work rapidly as well as accurately, which accounts for many of the interesting tools and machines which have been developed.

As cylinders vary greatly in size and are used for many different purposes, naturally many different forms of tools and types of machines are employed for machining the interior cylindrical surface or "bore," as it is commonly called. Many cylinders are bored on standard machine tools which are adapted to other operations, but the extensive use of cylinders in some lines of manufacture has led to the development of special tools and machines designed exclusively for cylinder work.

The most interesting practice in machining cylinder bores is found in automobile factories and other plants making motors of the internal combustion type, owing to the fact that such motors require a compressed charge, and a lack or loss of compression causes a decided reduction in the power of a motor. For this reason, it is necessary to finish motor cylinders accurately as to diameter and as truly cylindrical as it is practicable to make them, in order to secure a minimum of clearance between the piston and the cylinder wall. The problem of tool designers, manufacturers of reamers or cylinder boring machines, and others concerned with efficient methods of finishing motor cylinders, has been to secure not only accurate work, but also maximum production. Since the machines and tools which have been developed for use in automobile plants are exceptionally interesting, this class of equipment and the important variations in practice will be described completely. While the cylinders of steam engines, pumps, air compressors, etc., require less accuracy as a class than cylinders of internal combustion motors, a few examples typical of this kind of cylinder work, will be included to illustrate the general procedure and some of the different types of tool equipment used. No attempt will be made to deal with every possible method of machining interior cylindrical surfaces, but the article will be confined prin-

Fig. 1. Vertical Six-spindle Cylinder Boring Machine

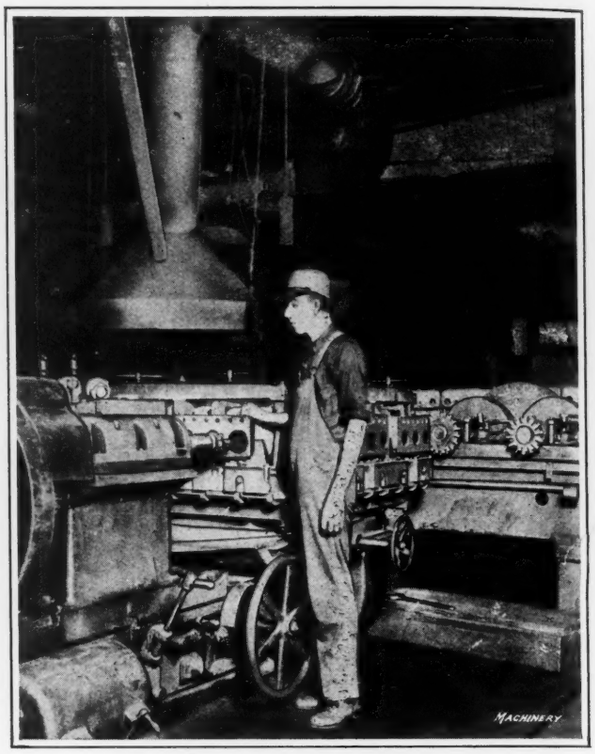


Fig. 2. Combination Cylinder Boring and Milling Machine

cipally to the machines that have been designed primarily for cylinder work and to the auxiliary tools used in conjunction with these machines.

General Methods of Machining Cylinder Bores

The methods of machining the bores of various types of cylinders may be broadly classified as (1) boring; (2) boring and reaming; (3) boring and grinding, or boring, reaming, and grinding; (4) boring, reaming, and lapping; (5) boring, reaming, and rolling or planishing. The particular method adopted and the type of machine used depends largely upon the size of the cylinder, the degree of accuracy necessary, and the quality of finish or smoothness of the surface. The quantity of the work required, or the number of cylinders to be bored, is also an important point to consider in determining the type of tool equipment, especially in the case of relatively small cylinders, and the design of the cylinder itself may affect the method of machining.

The common method of finishing large cylinders for steam engines, air compressors, and other machines of this

Fig. 3. Six-spindle Cylinder Boring Machines used by the Continental Motors Corporation

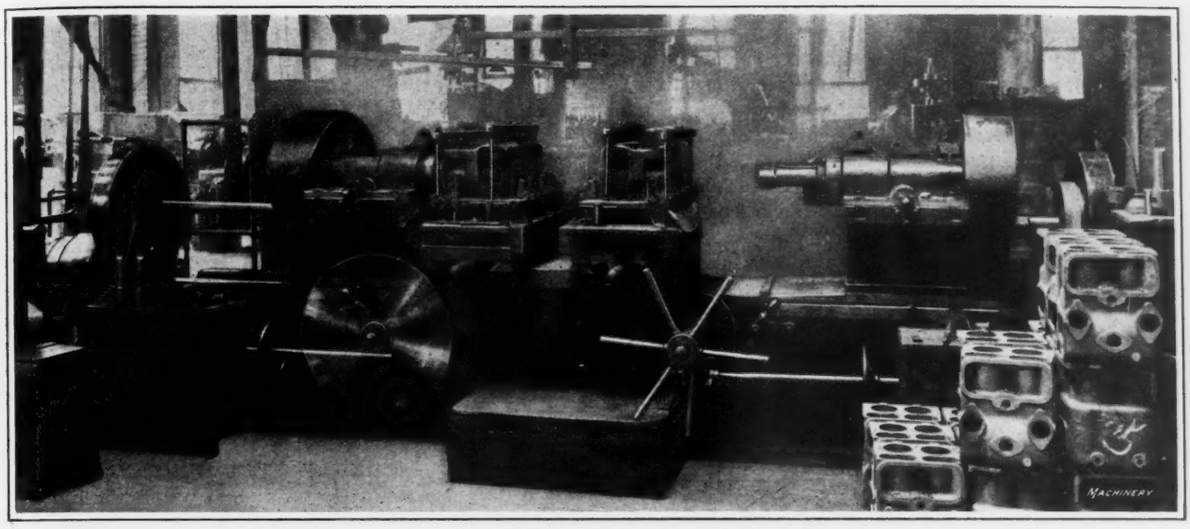


Fig. 4. Horizontal Double-head Four-spindle Machine used for boring Cylinders prior to grinding

general class is by boring, suitable roughing and finishing cuts being taken with one or more single-point cutting tools. Cylinders of smaller size are frequently bored and then finished with some form of reaming tool which takes a very light cut to remove the tool marks left by the roughing cutter and, at the same time, finish the bore to a given diameter within close limits. Many of the small cylinders, however, especially of the type used on the motors of automobiles, airplanes, motor boats, etc., are finished by grinding, after the bulk of the metal has been removed by boring and reaming tools. There is a decided difference of opinion among manufacturers as to the relative advantages of finishing cylinder bores by reaming as compared with grinding. Some of the important reasons for this variation of practice will be discussed later in an article on cylinder grinding.

When a cylinder is finished by the lapping process previously mentioned, a lap or piston is inserted in it and is usually given a combined reciprocating and rotary motion; then by applying oil and a suitable abrasive the cylinder wall is finished. A lap without an abrasive may also be used as described later. The rolling or planishing process is not so common as the others referred to; in fact, very few manufacturers have adopted this method, which, in brief, consists in rolling the cylinder wall by passing a cage of revolving rollers or balls through the bore.

Different Classes of Cylinder Boring Machines

The general methods of boring and finishing cylinders differ in regard to the method of presenting the tool to the work and of obtaining the necessary rotating and feeding movements. For instance, the tool may be held stationary except for the feeding movement, while the cylinder is revolved, or this order may be reversed. In some cases, the tool is given both a rotating and feeding movement, the exact arrangement depending upon the type or design of the machine. All cylinder boring machines may be included

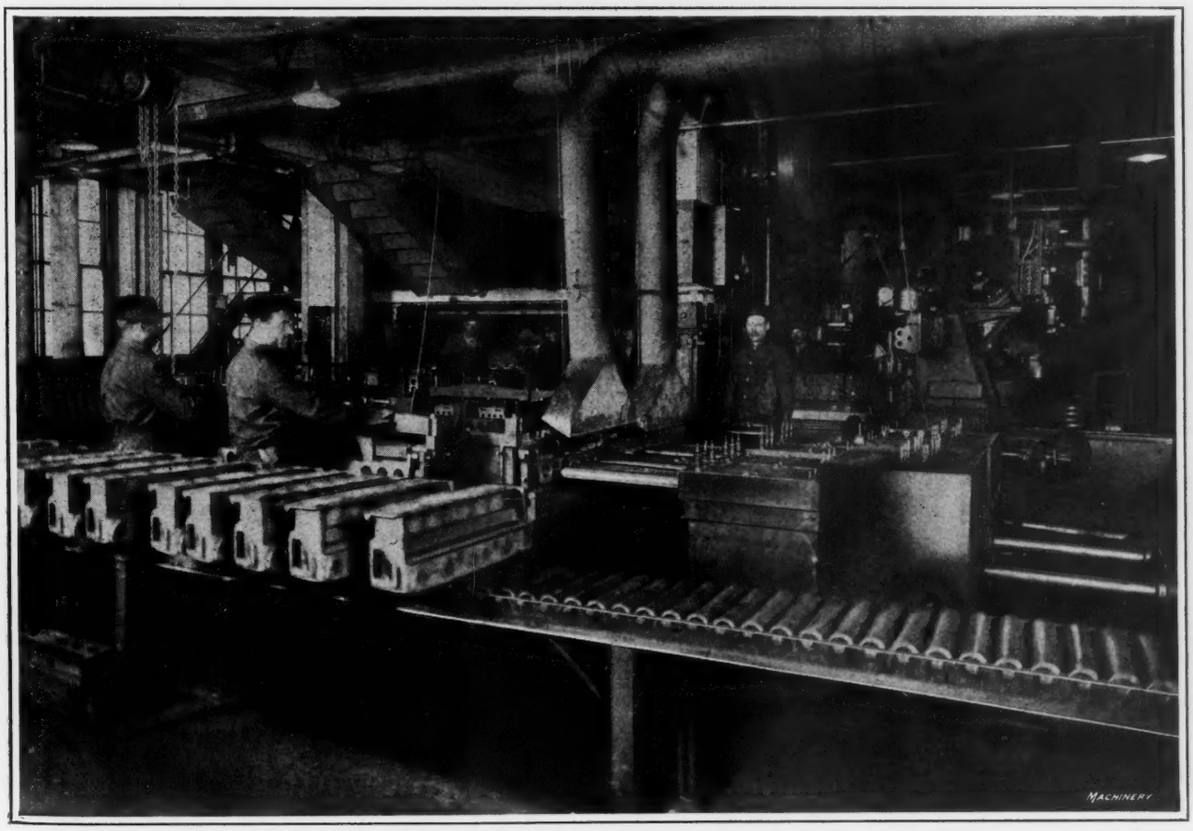


Fig. 5. A Combination Cylinder Boring and Milling Machine now used by the Packard Motor Car Co.

in one of three general classes designated as (1) machines designed exclusively for cylinder boring; (2) machines which may be adapted for cylinder boring but are intended for other operations as well; (3) portable machines or boring-bars which are applied to the cylinder to be bored. The first class includes both horizontal and vertical designs which vary considerably in regard to the general arrangement of the various details. The machines of this class will be referred to principally, variations in design being considered more in detail later. The second class of machines mentioned which are not designed primarily for cylinder boring, but which are adaptable to it, includes such machines as engine lathes, turret lathes, and horizontal and vertical boring machines. The third class includes the various forms of portable boring-bars which have their own feeding mechanism and (with the exception of hand-operated tools for truing small cylinders) are designed for a power drive, either by belt or by a direct-connected motor.

The cylinder boring machines of vertical design have been extensively used for automobile engine cylinders. These vertical-spindle machines differ in regard to the number of spindles, the mounting and driving of the spindles, the method of obtaining the feeding movement for the cutting tool and in regard to the extent of automatic control. When two or more cylinder bores are formed in one solid casting or en bloc, the common practice is to use a machine having as many spindles as there are cylinder bores in the casting, so that each bore can be operated on at the same time, except when cylinders are finished by reaming, in which case, single-spindle machines are preferred by some manufacturers for the final reaming operation. Some of these multiple-spindle machines are so constructed that the spindles may be adjusted along a cross-rail for varying the center-to-center distance, whereas on other machines the spindles are fixed so far as lateral adjustment is concerned. Machines having the non-adjustable spindles are designed for exclusive use in a factory which requires so many cylinders that one or more special machines are in constant use boring cylinders of one size. The feeding movement of some vertical-spindle designs is obtained by elevating the work-table whereas on other machines the work-table and cylinder remain stationary and the spindle head is traversed along the vertical face of the column. These vertical-spindle machines used on automobile work are usually semi-automatic, the feed mechanism being arranged to disengage when the cut is completed. The return movement may also be controlled automatically.

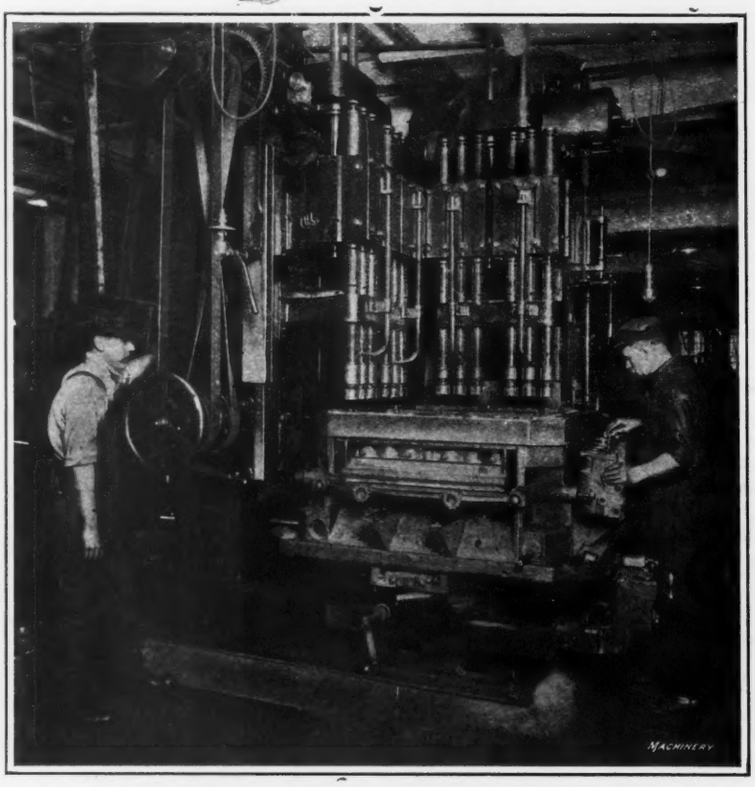


Fig. 6. Twelve-spindle Vertical Cylinder Boring Machine having Two Groups of Six Spindles located in Planes at Right Angles to Each Other

Vertical Six-spindle Cylinder Boring Machines

One of the cylinder boring machines used by the Continental Motors Corporation is shown in Fig. 1. This is a six-spindle fixed-center type, which is manufactured by the Foote-Burt Co., Cleveland, Ohio. It is shown in the illustration boring two three-en-bloc cylinder castings at the same time, or two castings each containing three bores. When the machine is in operation, the table feeds upward until the boring tools have entered to the proper depth, when the power feed is automatically disengaged. A brake is provided to stop the spindle quickly at the end of a cut which prevents scoring the cylinders as the table is lowered to the starting position. Counterweights at the rear of the machine are connected with the table by means of chains which are attached at points directly in line with the spindles. One of these chains may be seen at the side of the fixture in the illustration. This fixture has a removable jig-plate equipped with hardened and ground steel bushings. Bronze bushings on the spindles of the boring machine fit closely into these jig-plate bushings and support the spindles while the boring tools are at work. Two exhaust pipes connect with the base of the fixture and extend down beneath the machine for exhausting the dust. A machine of this kind which has fixed-center or non-adjustable spindles is adapted for plants producing so many motors of one size that spindle adjustment is not necessary. Some Foote-Burt machines are arranged so that the center-to-center distance between the spindles can be varied if necessary.

The six-spindle cylinder boring machines shown in Fig. 3 are also used by the Continental Motors Corporation. These machines are the product of the Moline Tool Co., Moline, Ill. The cylinders in this case are the six-en-bloc type, six bores being formed in one solid casting. The spindles of these machines are adjustable for varying the center-to-center distance, although they are rigidly tied together. These spindles are driven by the well-known spiral type of drive. The work-table feeds upward while boring, the feeding motion being transmitted through racks and pinions. The hand-operated movements of the work-table are controlled by the pilot wheel which the operator is holding in the illustration. An adjustable stop on a vertical rod located just back of the pilot wheel controls the point at which the power feed is disengaged when the cutters have entered to the correct depth. This adjustable stop is engaged by an arm attached to the work-table. The fixtures on these machines have top jig-plates with bushed holes for guiding and steadying the spindles. The view to the right shows the jig-plate raised above the body of the fixture. Some Moline cylinder boring machines have sleeves which extend down to the nose of each spindle. This design is used when the fixture is without a top jig-plate.

Horizontal Double-head Four-spindle Machine

The type of cylinder boring machine used by the Winton Motor Car Co., Cleveland, Ohio, is illustrated in Fig. 4.

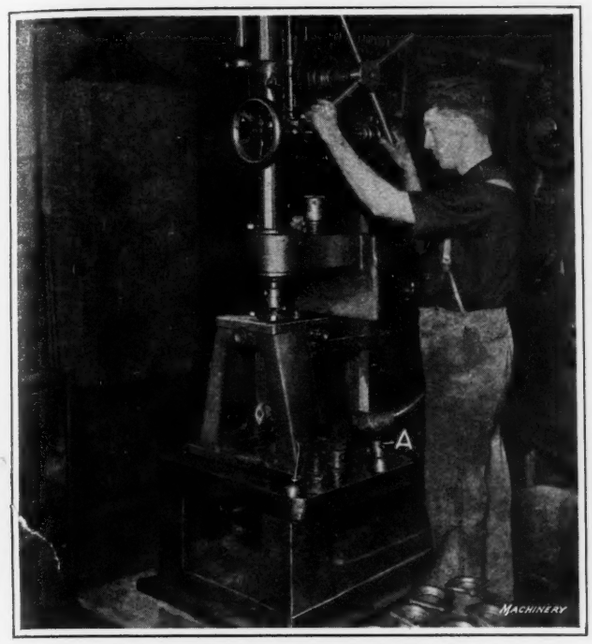


Fig. 7. Rough- and Finish-boring on Single-spindle Machine

This is a Beaman & Smith duplex machine having two spindle heads and two work-holding tables mounted on a horizontal bed. Each head has two spindles, and when the machine is in use, two cylinder castings are held on each work-table. These castings are of the two-en-bloc design and are used for the six-cylinder motor. A pile of castings may be seen at the right in the illustration. When the machine is operating, one spindle enters the bore of a casting while the other spindle in the same head enters the corresponding bore of the other casting on the same work-table. After one bore in each casting has been roughed out, the work-table is moved in a crosswise direction for locating the spindles opposite the two remaining bores. The table is accurately located in the two positions by a plug which enters properly spaced holes. Only one boring cut is taken prior to the grinding operation. The cylinders are rough-bored to within about 0.006 inch of the required size. This practice of taking only one roughing cut is unusual, and is partly made possible by accurate foundry work, cylinder bores being cored to within about ⅛ inch of the final size.

Combination Cylinder Boring and Milling Machine

The combination boring and milling machines used at the plant of the Packard Motor Car Co., Detroit, Mich., are so arranged that the bottoms or crankcase ends of the cylinder castings are face-milled, and then the castings are bored on the same machine and without removing them from the fixture. A general view of one of these machines is shown in Fig. 2. The cylinders are roughed out on this machine (which is made by the Beaman & Smith Co., Providence, R. I.) and are afterward reamed and ground. Eight cylinder castings are held in the fixture at one time and the work-table is located between the boring spindles and the milling cutters. The boring spindles are at the left of the operator on this particular machine, and the milling cutters, at the right. The saddle carrying the two milling-cutter spindles is mounted on a small cross-bed located at right angles to the main bed. The work-table is revolved one-quarter revolution after the two castings on one side have been milled, and two on the opposite side have been rough-bored. This indexing movement of the work-table locates two rough castings in front of the milling cutters and two which have been face-milled, in front of the boring spindles. The work-table is provided with a ball bearing which is raised by a handwheel and takes the weight of the table, so that it can be revolved or indexed easily. The work-table, however, does not rest upon this ball bearing when the machine is at work milling and boring, but on a straight surface of large diameter. The table is accurately located in any one of its four positions by a locking pin which enters one of four holes, and it can be securely fastened after being located by this pin. The spindle head moves along the bed to provide the feeding movement for boring, and it has a rapid traversing movement. The saddle carrying the milling cutters also has a rapid power traverse.

The Beaman & Smith boring and milling machine now used at the Packard plant for the six-en-bloc cylinders is illustrated in Fig. 5. This machine has the same general features as the older design previously described, except that there are twelve spindles on the boring side instead of six. These spindles are located at the right-hand end of the machine as shown in the illustration. The fixture is arranged to carry eight six-en-bloc castings. The roller platform or track seen in the foreground is used to convey the cylinders from one machine to another. The two pipes located just above each group of boring spindles are for exhausting the dust. In operating a machine of this type, the principal work is to remove the bored castings and insert rough ones in the fixture. After the rough castings are placed in the fixture, the indexing movement of the work-table locates the castings in front of the milling cutters, where the crankcase ends or faces are milled before the boring operation. The cylinders are rough-bored to within 0.100 inch of size on this machine, and then they are reamed prior to grinding on a multiple-spindle vertical machine.

Twelve-spindle Vertical Cylinder Boring Machine

The twelve-spindle Beaman & Smith machine used for reaming Packard cylinders prior to grinding is illustrated in Fig. 6. The two groups of six spindles each are located in planes at right angles to each other, so that the loading and unloading positions of the fixture or work-table are at adjacent sides instead of being at the front and rear. This machine is designed, of course, to ream two cylinder castings or twelve cylinder bores simultaneously. The machine is semi-automatic in its operation, the downward feed of the spindle slides being automatically disengaged when the cutters have reached the desired depth. The cutter-bars are driven through floating connections and the bars

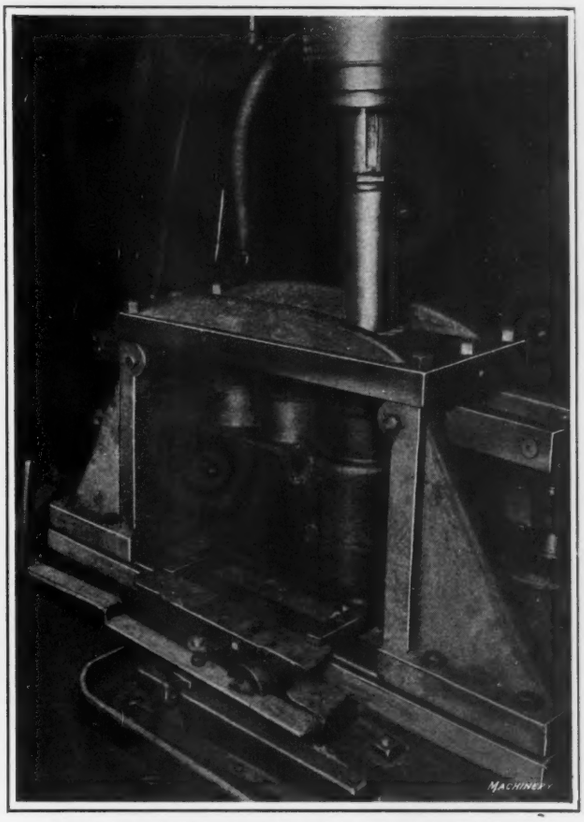


Fig. 8. Reaming Multiple Cylinders on a Single-spindle Machine

are guided and steadied by bronze bushings which enter the upper ends of the cylinder bores. Each group of three spindles is provided with a presser-foot which is free to move upward against the compression of a spiral spring that surrounds the upper end of the presser-foot rod. As the cutter-bars descend, each presser-foot automatically forces three guide bushings down into holes in the top of the fixture. When the cutter-bars are removed at the completion of the reaming operation, the bushings are carried up with the spindles so that the operator does not have to bother with this feature. Each casting is located in the fixture by two pins which engage holes near the ends. The finished face of the casting is forced upward against the top of the fixture by clamps below the casting.

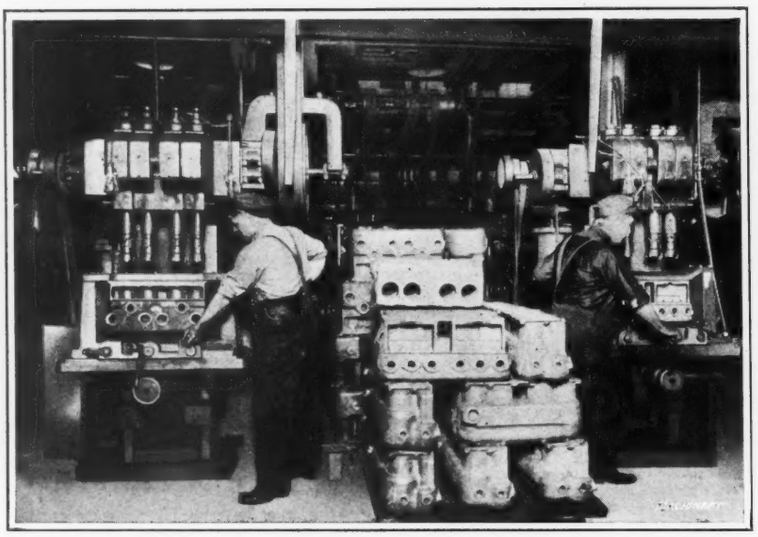


Fig. 9. Two of the Cylinder Boring Machines used by the Ferro Machine & Foundry Co.

Rough- and Finish-boring on a Single-spindle Machine

At the plant of the H. H. Franklin Mfg. Co., Syracuse, N. Y., the cylinders are bored prior to grinding on Baker single-spindle machines. One of these machines equipped for cylinder boring is shown in Fig. 7. Each casting has a single bore, and, before the boring operation, the cylinder flange is rough-faced on a vertical boring mill. Roughing and finishing cuts are also taken in the bore itself to a depth of ¾ inch. This part of the bore is finished to the size of a locating plug corresponding to plug *A* in the illustration. This plug is 1/16 inch smaller in diameter than the final size. The end of the bore is also chamfered during this preliminary operation. The cylinder is now ready for the machine shown in Fig. 7. It is located in the fixture by plug *A* which is inserted in a bushing in the fixture and engages the part of the bore previously machined. The cylinder is clamped against the top of the fixture by four clamp bolts and four screws and it is further secured by a screw at the bottom of the fixture which bears against the cylinder head. The roughing cutter has six blades or cutters, and it leaves from 0.060 to 0.070 inch in the bore. The head or end of the cylinder is next rough-faced with a double-blade tool, after which a second cut is taken through the bore with a six-blade tool which leaves from 0.013 to 0.015 inch for the final grinding operation. The casting is not removed from the fixture until it is finished, ready for grinding. The machine has a special spindle with a screw at the end which enables the cutters to be changed rapidly. The output of one machine usually varies from seven to eight castings per hour. The single-spindle machine has proved satisfactory for this work on the cylinders.

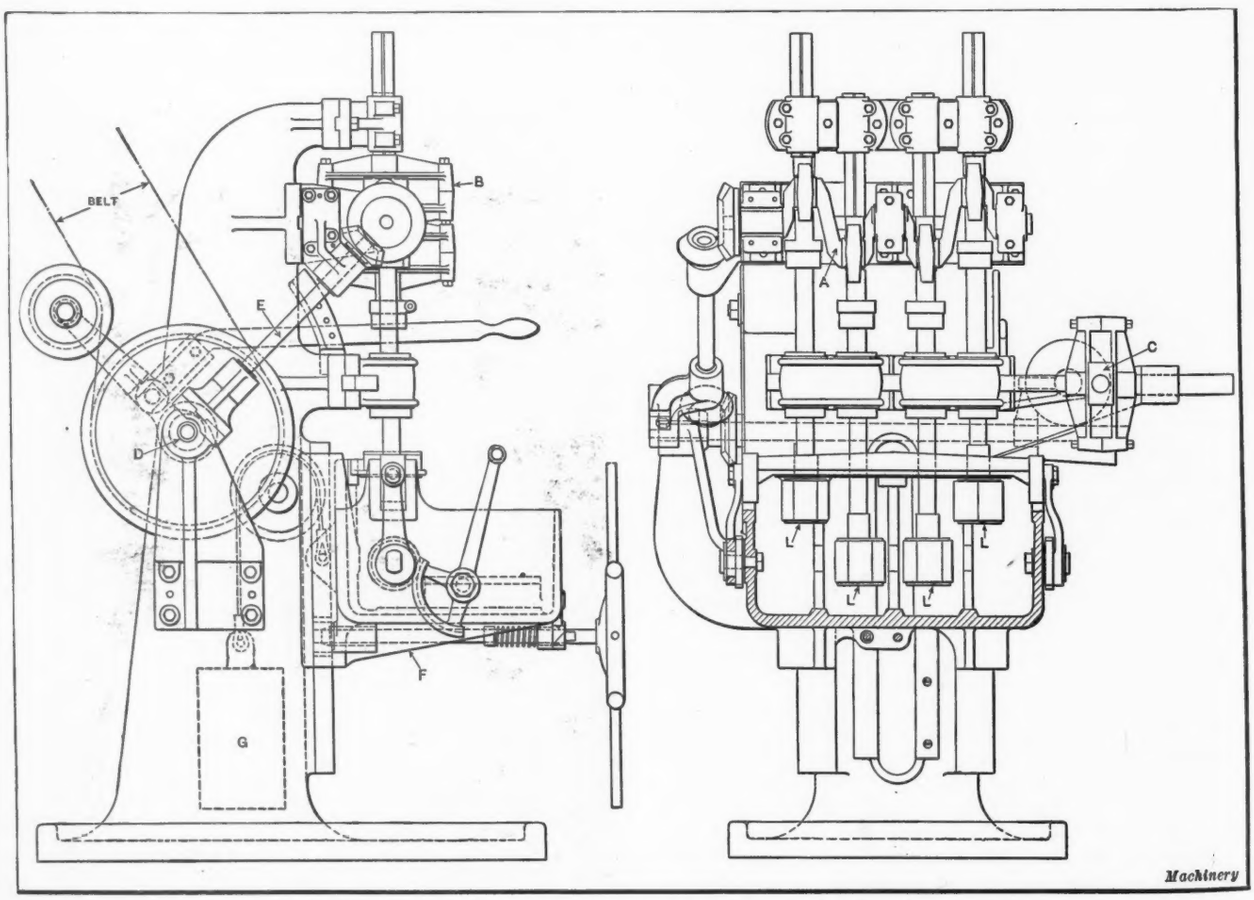


Fig. 10. Machine of Multiple Type for lapping Cylinder Bores after Reaming Operation

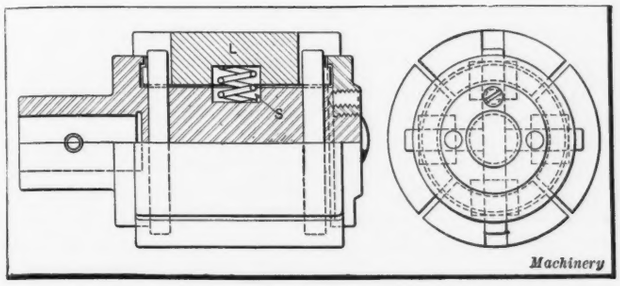


Fig. 11. Design of Lap used in Connection with Machine shown in Fig. 10

Finish-reaming on a Single-spindle Machine

Some automobile and gas engine manufacturers who finish cylinder bores by reaming, prefer to use a single-spindle machine for the final reaming operation in preference to a multiple-spindle machine. One object of using a single-spindle machine instead of a multiple type is to obtain greater uniformity in the diameter of different bores by finishing each bore with the same reamer. Fig. 8 illustrates how cylinders are reamed on a single-spindle Colburn drilling machine at the plant of the H. J. Walker Co., Cleveland, Ohio. These three-en-bloc cylinders are for Chandler cars, and the bore is 3½ inches in diameter and 9 inches long. Forty of these castings, or 120 cylinder bores, are reamed in nine and one-half hours.

The cylinders are first rough-bored on a double-column, twelve-spindle Beaman & Smith machine of vertical design, and then they are reamed. The fixture for this reaming operation is provided with a suitable indexing device for locating each of the three bores in the reaming position. This indexing movement is controlled by a plunger which engages three equally spaced holes in the fixture slide. The hand-lever for operating this plunger may be seen at the front of the fixture. The casting is held against the upper part or bridge of the fixture by means of pneumatically-operated clamps. Each clamp is pivoted near the top of the fixture and the outer end is attached to the pneumatically-operated piston or plunger. When the air pressure is released, the clamps are withdrawn from the casting by means of spiral springs so that they do not interfere with removing the finished casting or inserting a rough one.

Multiple reaming was superseded by the single-spindle method of reaming, because it was considered practically impossible to finish all the bores in any one casting to the same size without using the same reamer in each bore. Another disadvantage mentioned in connection with multiple reaming is that if one reamer does not cut properly, the entire machine must stand idle while a new reamer is being fitted and tried. The experience has been that a new reamer usually has to be stoned a little after trial to make it cut smoothly. On the contrary, if two or more single-spindle machines are used for reaming, when a reamer does not cut properly, only one machine is affected.

Heating Reamers before Using to Avoid Errors Due to Expansion

The practice of the Ferro Machine & Foundry Co., Cleveland, Ohio, in machining cylinder bores varies somewhat according to the specifications of the customer. Some cylinder bores are finished by reaming and others by grinding. When cylinders are finished by reaming, the reamers are heated, before using, to approximately the temperature to which a cold reamer would be heated as the result of the reaming operation. The object of this preliminary heating is to bring the reamer up to the working temperature when the operation is first started, thus avoiding errors resulting from expansion.

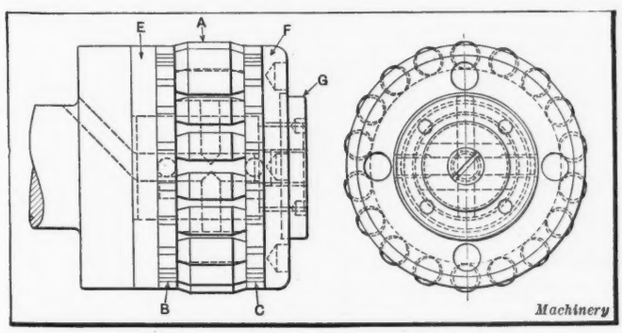


Fig. 12. Rolling Tool used for finishing Cylinder Bores by the Rolling or Planishing Process

Fig. 9 shows two of the boring machines used in this plant. If the cylinders are to be finished by reaming, either three or four cuts may be taken, depending upon conditions. When there are three cuts, a four-blade tool is used for roughing; a six-blade tool, for the semi-finishing cut; and a twelve-blade floating reamer for finishing. The feed for the heavy roughing cut is 1/32 inch; for the semi-finishing cut, ⅛ inch; for the reaming operation, 3/64 inch. The cylinder bore is enlarged about ⅛ inch by the semi-finishing cut and 0.020 inch by the reamer. If the cylinder bores are rather long or the ends of the cylinders closed, two semi-finishing cuts may be taken to insure getting the bore square with the face or flange. The cylinders shown in Fig. 9 have bores 4 inches in diameter and 9 inches deep, and about sixty of these four-cylinder castings are bored in ten hours.

Speeds and Feeds for Reaming

The Gisholt Machine Co. recommends a cutting speed for reaming equal to about one-third or one-half the highest cutting speed for rough-boring; thus, if the speed for roughing is 40 feet per minute, the approximate reamer speed would be from 15 to 20 feet per minute. When reaming cylinders or other work requiring a very good finish, the speed might be reduced. A feed of about ¼ inch per revolution is recommended for reaming cylinders. The feed for reaming steel varies considerably more than for cast iron, owing to the difference in hardness. Soft steel requires a finer feed than steel having a higher carbon content. The feeds for reaming steel usually vary from about 0.040 to 0.125 inch. For reaming steel, the reamer should be flooded with lard oil or some cutting compound.

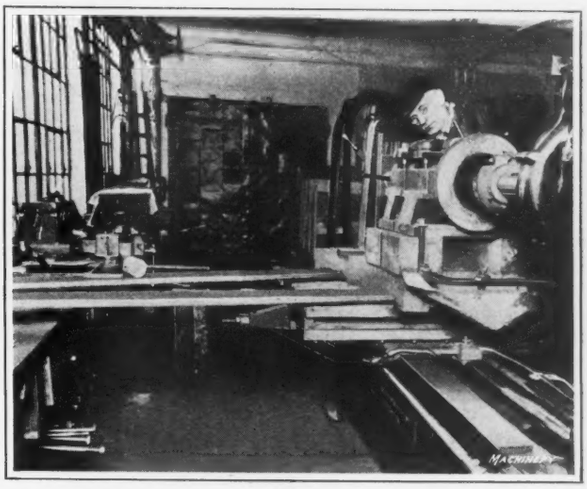


Fig. 13. Horizontal Boring Machine equipped with Special Attachment for boring Radial Cylinders

The speeds and feeds recommended by the National Tool Co., Cleveland, Ohio, for reaming cast-iron cylinders with the reamers of this company are as follows: When two roughing reamers are used, the first one should operate at a speed of 38 feet per minute, with a feed of 1/16 inch per revolution, using soda water. The cylinders should be placed in an oven or furnace to dry them thoroughly, before using the semi-finishing or the floating finishing reamer, assuming that soda water is used for the roughing cut. The semi-finishing or second roughing reamer should have a speed of 32 feet per minute, and a feed of ⅛ inch per revolution.

This reamer should remove 0.060 inch of stock and the cut should be taken perfectly dry. The speed recommended for the floating finishing reamer is 27 feet per minute and the feed 3/32 inch per revolution. This cut is also taken perfectly dry and tests have shown that the best allowance for finishing with the reamer referred to is 0.010 inch.

Heat-treatment of Cylinder Castings after Rough-boring

It is the practice of some automobile and other manufacturers of gasoline engines to subject cylinders to heat-treatment for relieving the internal stresses in the casting. The heat-treating process follows the rough-boring operation, although it is not always the next successive operation. The practice of the White Co., where cylinders are finished by boring, reaming, and grinding, is to first bore and ream the castings, and then heat them to 500 degrees F., for a period of four hours. The intention is to heat the casting before the final grinding operation to as high a temperature as it will be subjected to in practice. The cylinders are then ground after any changes have occurred which might result from the internal stresses that are released during the heating period.

At the Studebaker plant, castings are heat-treated as soon as they are rough-bored. Gas-fired furnaces are used, and the temperature is raised to 575 degrees F. This heat-treating process requires about forty minutes. The castings are then removed from the furnace and allowed to cool in the atmosphere. After any existing stresses have been relieved, the other machining operations on the bore are completed.

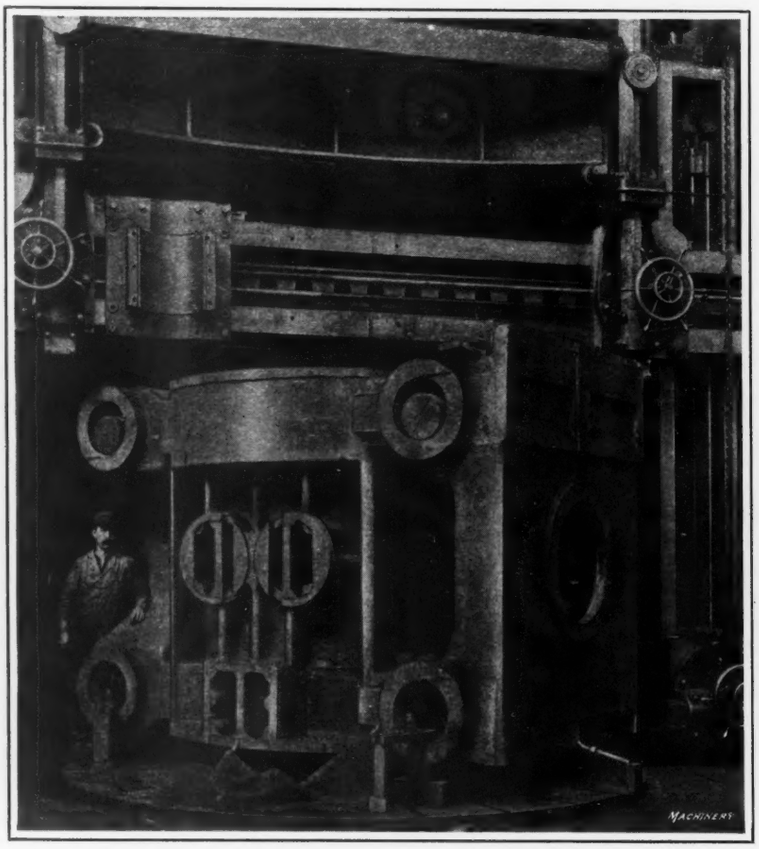


Fig. 14. Boring a 78-inch Cylinder on a Vertical Boring Mill

Scleroscope Test for Cylinder Castings before Boring

It is the practice of the Reo Motor Car Co., Lansing, Mich., to test the hardness of cylinder castings before boring, by using a scleroscope. The scleroscope test is applied to a certain percentage of the castings in each shipment, and if many hard castings are found, the test is applied to the entire lot. The average run of castings have a hardness of between 30 and 40 on the scleroscope scale. The relatively hard castings are grouped together and machined separately, because it has been found that uniformity in the castings enables them to be machined to better advantage.

Machine for Lapping Reamed Cylinders

The standard practice in finishing the cylinders of Studebaker motors is by lapping on a special machine designed for this purpose. The machining operations on the cylinder bore include (1) a rough-boring cut; (2) a lighter roughing or semi-finishing cut; (3) finish-reaming; and (4) lapping. The lapping machine is provided with six spindles which serve to lap the six cylinder bores simultaneously. The general type of machine used is illustrated in Fig. 10, which shows the four-spindle design. The lapping spindles and laps *L* are given a combined reciprocating and rotating motion. The reciprocating movement is derived from a crankshaft *A* at the top of the machine. The lapping spindles connect with this shaft by means of Scotch yokes *B*. The rotary motion is reversing, the laps being turned about one-half revolution in first one direction and then the other. This reversing rotary movement is derived from a crank *C* which transmits motion through a Scotch yoke connection and horizontal rack, meshing with pinions which are splined to the lapping spindles. The main driving shaft extends along the rear of the machine at *D*. This shaft drives the main crankshaft *A* through shaft *E* and the bevel gearing shown. The casting to be lapped is placed within work-table *F* which is enclosed at the sides to form a reservoir for the kerosene used in connection with the lapping operation. This work-table may be raised and lowered upon the vertical face of the machine column and it is attached to a counterweight *G*. Each spindle has attached to its lower end a cast-iron lap. No abrasive whatever is used, the lap simply being traversed through the cylinder bore which is continually flooded with kerosene. A detail view of one of these laps is shown in Fig. 11. The lapping surface is formed of four cast-iron segments *L*. These segments are free to expand, being forced outward against the cylinder wall by a spring *S* which exerts a pressure of about 30 pounds. These laps are traversed through the cylinder bores at the rate of about 480 strokes per minute, and from twelve to twenty minutes is required for lapping a cylinder casting.

Finishing Cylinder Bores by Rolling or Planishing

The rolling or planishing method of finishing cylinder bores consists in feeding down through the bore a cage of hardened rollers or balls which enlarge the bore slightly, thus sizing it and at the same time producing a hard dense wearing surface. This method has been used by only a few manufacturers, although when properly applied it seems to be entirely satisfactory; in fact, the cylinders of Ford cars are finished in this way. The hardened steel rollers are mounted in a cage so that they are free to turn and are located parallel with the axis of the cylinder. These rolls are not exactly cylindrical but are ground with a slight curvature, the diameter in the center being about 0.001 inch larger than at the ends. There are approximately twenty of these rollers and as the cage, which is attached to the machine spindle, feeds downward, the rollers compress the metal and slightly enlarge the bore to the finished size. The

cage of rollers should be oiled freely while it is passing through the cylinder. Formerly, this work was done on a single-spindle drilling machine, but now a four-spindle machine is used for rolling the four bores at the same time. Prior to this rolling process, the cylinders are carefully reamed to give the necessary allowance for rolling. This general method of finishing cylinders has also been used for finishing the bores of some motorcycle cylinders.

Rolling Process as Applied to Motorcycle Cylinders

The cylinders of Henderson motorcycles, manufactured by the Excelsior Motor Mfg. & Supply Co., Chicago, Ill., were formerly finished by the rolling or planishing process. After two years' experience with the rolling of cylinder bores, this method has been replaced by grinding to obtain the final finish. The following report of the Engineering Department explains why the rolling process was discontinued, and includes some important data and information pertaining to the rolling method of finishing motor cycle cylinders:

While the rolling process is an improvement over reaming, it is not as dependable as grinding. The rolling smooths and hardens the surface and reduces friction a great deal, but the cylinder is still a reamed job and subject to the defects caused by reamer troubles. If the reamer could be made to ream a perfect bore continuously, reamed and rolled cylinders would prove to be even superior to ground cylinders. When the Henderson cylinders were rolled, they were finish-reamed in a vertical position with a Kelly reamer. The bore was 2⅝ inches in diameter. The cylinders were reamed to 2.6245 inches, allowing only 0.0005 inch for rolling, as not more than 0.00025 inch of metal could be rolled down on a side. The outside diameter of the roller cage was 2.6265 inches, indicating that the cylinder was sprung open 0.002 inch by the pressure of the rolls and back to size when released. On account of this pressure, the process could not be used on all cylinder designs. The Henderson cylinder design was all right on account of the even distribution of air-cooling flanges. The construction of the cage of rollers is similar to that of a regulation roller bearing. For rolling a 2⅝-inch cylinder, a cage of eight rollers was used. The rollers were ⅜ inch in diameter and 1 inch long. A ball bearing should be used above the cage to take the thrust. The cage should be made as strong as possible, as the twisting strain on the rollers is severe. The rollers need not have much "lead" or curvature, a slight radius at the ends being sufficient. The rolling should be done at about the same feed and speed as for reaming. The cost of rolling a cylinder bore is much less than grinding, the production being fully three times as fast.

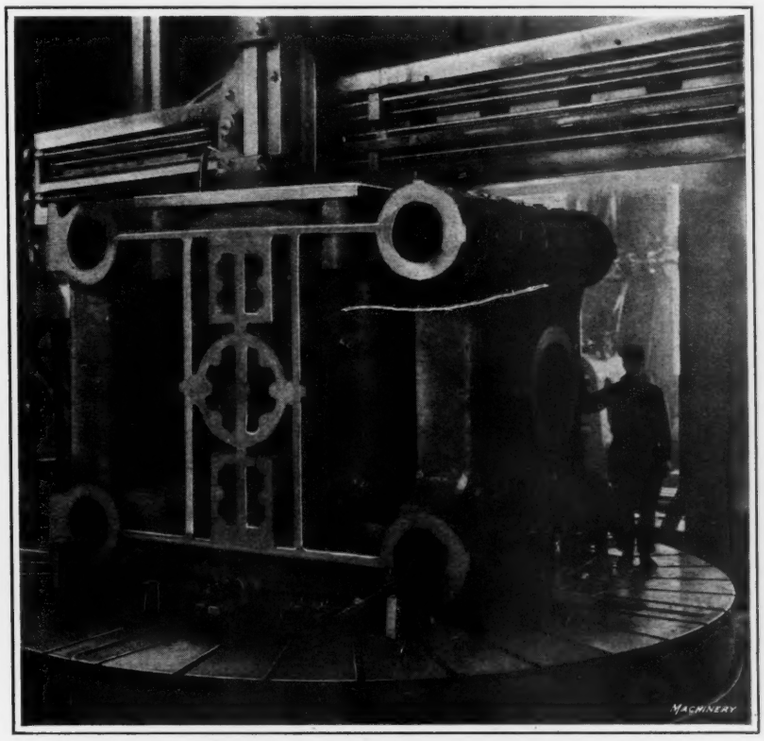


Fig. 15. Boring an 84-inch Cylinder on a Vertical Boring Mill

Tool for Cylinder Rolling

While the cylinders of Studebaker motors are finished on a lapping machine, as previously described, the rolling process is applied under certain special conditions. The interesting design of rolling tool used is illustrated in Fig. 12. This tool has eighteen hardened steel rollers *A*. The central part of these rollers, which comes into contact with the cylinder bore, is ⅜ inch in diameter. The rollers are tapering at each end and beyond the tapering part there is a cylindrical bearing which engages the retainers *B* and *C*. The rollers are not located parallel with the axis of the tool, but are set at an angle of 1¼ degree, so that the tool readily feeds itself through the cylinder bore. As the illustration shows, the rollers are so inclined that the leading ends are slightly back of the following ends, which causes the tool to advance through the cylinder bore. The rate of feed is about ¼ inch per revolution. The diameter over the rollers is approximately 0.001 inch larger than the finished diameter of the bore to be rolled. When the tool is in use, the rollers bear between the wall of the cylinder and a hardened and ground collar, which is free to revolve about a bushing attached to a central stem on the holder. Washers *E* and *F* are placed on each side of the cage of rollers, and a nut *G* is screwed onto the end of the holder to keep the parts in position. This tool is used on a drilling machine having a tapping attachment, so that the spindle may be reversed for backing the tool out of the cylinder bore. The wall of the cylinder springs slightly when being rolled. For instance, if the cylinder is 0.003 inch under size, it will not be enlarged exactly 0.003 inch by the rolling tool, but a little less, because the cylinder wall springs back slightly after the rolling operation

Special Radial Cylinder Boring Attachment

A very unusual cylinder boring operation and the special attachment required for it are shown in Fig. 13. The cylinders bored by using this attachment in conjunction with a horizontal boring, drilling, and milling machine are curved sections which form part of a pneumatic carrier system. Each section of the curved portion of the pneumatic tube had to be bored to a radius of 8 feet. The diameter of each section is about 8⅜ inches and the length, approximately 2 feet. The attachment is arranged to swing the cylinder casting about a radius of 8 feet as the machine table travels lengthwise along the bed. In order to obtain this swinging movement, two arms which are attached to the work-holding fixture are pivoted to a stationary pin located at a point farther to the left than is shown in the illustration. This radius boring attachment operates on the same general principle as some of the attachments used in locomotive shops for planing and also for grinding the links of the valve operating mechanism.

Boring Large Cylinders

Very large cylinders are usually bored on either vertical or horizontal boring machines of the general type designed for various other classes of work. If the length of the bore is rather long as compared with the diameter, it may be necessary to use a horizontal machine, but if the length of the bore is not excessive, the vertical type is often employed. As a general rule, very large cylinders, while being bored, should preferably be in the position they will occupy when

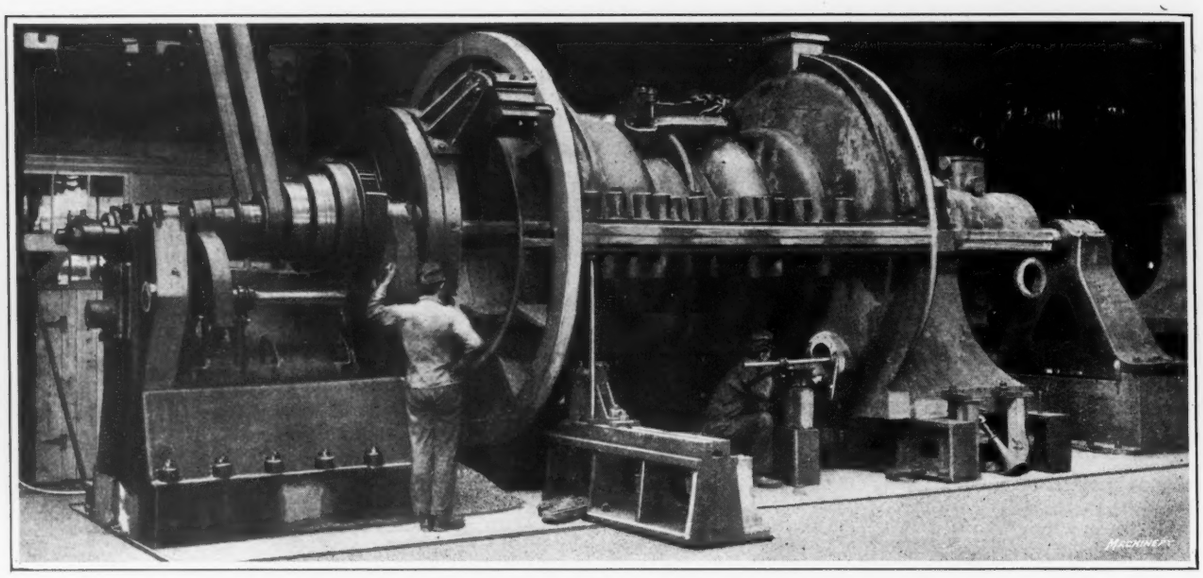


Fig. 16. Boring and facing the Casing of a Steam Turbine at the Plant of the Westinghouse Electric & Mfg. Co.

assembled and in use. For instance, a very large low-pressure cylinder for a vertical marine engine should be bored while in a vertical position, because if the horizontal boring machine is used, the cylinder is likely to spring slightly to an oval shape while being bored, so that it will not be true after it is finished and placed in a vertical position.

Fig. 14 shows an example of large cylinder boring on a vertical boring mill. This is a 78-inch low-pressure cylinder for a rolling mill engine, and it weighs 84,000 pounds. This is an example of the heavy cylinder work done at the West Allis Works of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Another very large cylinder is shown in Fig. 15. This is an 84-inch low-pressure steam cylinder, and the length of the bore is 60 inches. The vertical boring mill used for this work is a 20-foot size. This cylinder is intended for a horizontal cross-compound blowing engine built by the Mesta Machine Co., Pittsburg, Pa.

When setting a cylinder casting, if the design will permit, it should be set true by the outside of the flange or, better still, by the outside of the cylinder body, so that the walls of the finished cylinder will be of uniform thickness. The finishing cut should also be a continuous one, because if the machine is stopped even for a short time, the tool cools somewhat, and as the result of contraction a ridge is left in the bore. This is one reason why an independent drive is preferable for a boring machine, especially if the latter is used on large work which requires in some cases considerable time for taking a cut through the bore. A horizontal machine is shown in Fig. 16 boring and facing the casing of a steam turbine at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Special Machine for Engine Cylinders of the Corliss Type

Steam engine cylinders of the Corliss or four-valve type are often bored on a special type of machine having three boring-bars which may operate at the same time. One of these machines built by the Niles Works of the Niles-Bement-Pond Co., and installed at the plant of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., is illustrated in Fig. 17. The port boring attachment consists of two vertical columns which may be adjusted along the bed parallel to the main boring-bar. On the face of the larger column there are two saddles, each of which carries a port boring-bar which is additionally supported by a bearing on the other column, as the illustration shows. These saddles and auxiliary boring-bars are adjusted according to the center-to-center distance between the valve ports. The machine shown in Fig. 17 also has two heavy facing arms for facing the cylinder flanges at the ends of the cylinder. Each arm is provided with a tool-

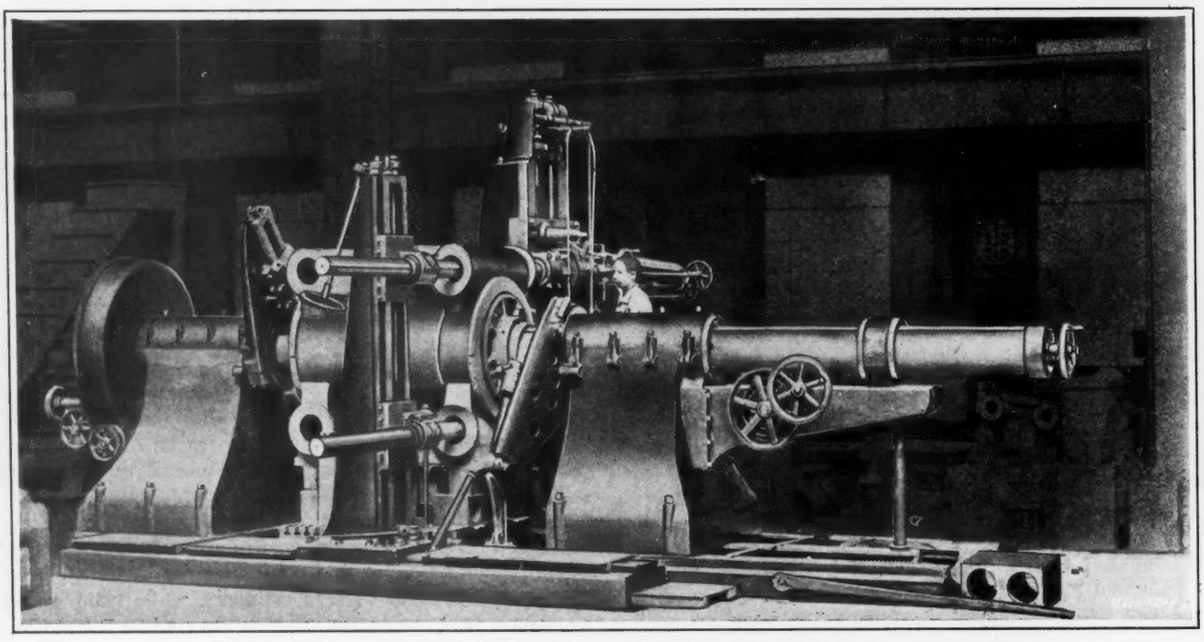


Fig. 17. Horizontal Boring Machine designed especially for Engine Cylinders of the Corliss Type

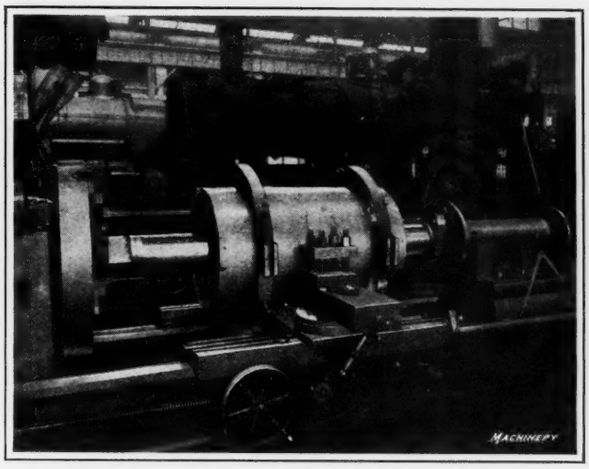


Fig. 18. Boring a Locomotive Cylinder Lining in an Engine Lathe equipped with a Boring-bar

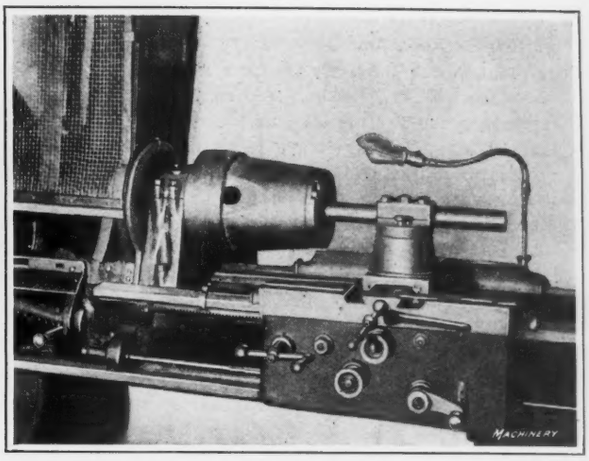


Fig. 19. Engine Lathe arranged for boring Cylinders of Airplane Motors at the Plant of the Curtiss Aeroplane & Motor Corporation

block or tool-slide and a feed-screw which is turned one-sixth revolution each time the main boring-bar makes a complete revolution. This feeding movement is derived from the well-known star feeding mechanism, there being a star-wheel attached to the end of the feed-screw which strikes a fixed pin.

Method of Grinding Single-point Cylinder Boring Tools

When single-point tools are used for taking the finishing cuts in cylinder bores, especially of the larger sizes, there are two general methods of grinding them. Some contend that a tool which has a rather narrow rounded point gives better results than one having a broad flat cutting edge. When a narrow tool is used, the feed is, of course, reduced accordingly, and it is claimed that greater accuracy is obtained because the tool is not deflected as much as one having a broader cutting edge when it encounters hard spots in the casting. The narrow ridges which may be left by a narrow tool are also regarded as an advantage by some mechanics, the contention being that they form minute pockets for oil and facilitate lubrication. If the boring machine, however, is sufficiently rigid to permit using a rather broad tool and a coarse feed for the finishing cut, the time for taking this cut can be greatly reduced and there is less wear on the tool since the work is done in less time. The massive boring-bars found on modern machines will not be deflected appreciably when a broad tool is used. When using some machines, it is necessary to reduce the width of the cutting edge in order to prevent chattering.

Cylinder Boring in Engine Lathes

Ordinary engine lathes are sometimes used for cylinder boring when a horizontal boring machine or some other type of tool better suited to such work is not available. If the cylinder casting is too large to be gripped in a chuck or bolted to the faceplate, it is clamped to the lathe carriage. One method is to place a boring-bar between the centers, which has one or more cutters centrally located and rigidly secured to it. As the boring-bar is revolved, the feeding movement is obtained by traversing the carriage along the bed with the regular power feed. In this case, the boring-bar must be about twice as long as the cylinder to provide room for the necessary feeding movement. Another type of boring-bar for use in the lathe is illustrated in Fig. 18, which shows how the lining of a locomotive cylinder is bored. The cutter-head in this case is traversed along the bar itself by a star feed mechanism and a lead-screw inserted in a groove extending along one side of the boring-bar. A disk or plate is attached to the tailstock spindle and carries a pin which strikes the star-wheel each time the boring-bar makes a revolution. The star-wheel is thus turned one-fifth revolution and this rotary movement is transmitted by means of spur gears to the lead-screw, which, in turn, actuates the cutter-head. Incidentally, the outside of this cast-iron lining is rough-turned before boring, in order to avoid the distortion which might occur if this hard outer surface were removed after boring. Special fixtures are sometimes provided for holding linings or cylinder castings to the lathe carriage to facilitate clamping and adjusting the work. When a cylinder lining or similar part must be bored in the lathe, if no fixture has been provided, wooden blocks clamped across the wings of the carriage at each end will serve the purpose. Circular seats having a radius equal to the outer radius of the lining may be cut into these blocks by using a special hook-shaped cutter attached to the boring-bar. The cutter is set to the required radius and it should revolve rapidly for this operation.

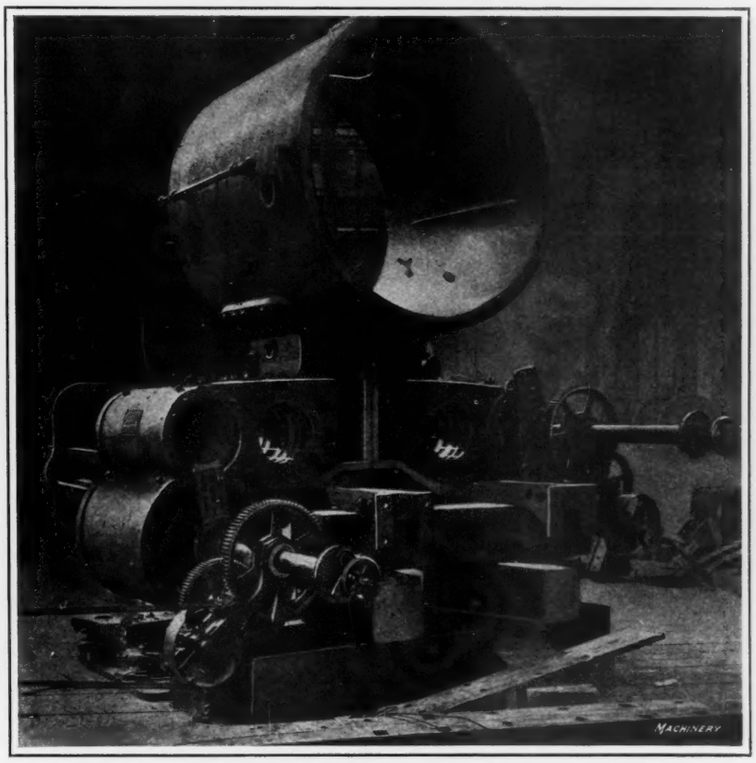


Fig. 20. Portable Boring-bars reboring the Worn Cylinders of a Locomotive

Boring Cylinders of Airplane Motors in Engine Lathe

Fig. 19 illustrates how an ordinary engine lathe is used at the plant of the Curtiss Aeroplane & Motor Corporation, Hammondsport, N. Y., for boring airplane motor cylinders. The cylinders are first rough-bored in a Jones & Lamson flat turret lathe, a special fixture being used to hold them in position. A double-ended boring tool mounted on a very heavy arbor attached to the turret is used for this preliminary boring operation. The second boring operation is performed on an engine lathe, as shown in Fig. 19. This lathe is equipped with a special work-holding fixture attached to the spindle and a very stiff single-ended boring tool is used. This method has been adopted to insure absolute alignment of the bore relative to the clamping flange. The cylinder is finally finished by grinding on a Heald cylinder grinder within a limit of 0.001 inch plus or minus from the standard diameter.

Portable Boring-bars for Cylinder Work

Portable boring-bars are often used for boring or reboring cylinders which are either too large to be placed on a fixed machine or which should preferably be bored while assembled. In locomotive repair shops portable boring-bars are used for reboring cylinders which have become worn by the reciprocating motion of pistons. These pistons which bear principally on the bottom of the cylinder, wear the latter out of round and also form shoulders at each end of the stroke. The general type of boring-bar used for truing worn cylinders is illustrated in Fig. 20, which shows two boring-bars operating at the same time on the cylinders of a dismantled locomotive. One of these boring-bars is boring a low-pressure cylinder and the other the high-pressure cylinder of the opposite side. The bar itself is carried by brackets attached to the front and rear ends of the cylinder. Power for driving the bar may be obtained from a portable electric motor connected by a belt, or a pneumatic motor of the type used for drilling may be applied directly to the shaft of the driving pinion. A handwheel is sometimes attached to the driving shaft when power is not available. As the illustration shows, motion is transmitted to the bar through a train of spur gearing. The cutter-head is traversed along the bar by a lead-screw which is placed in a groove or channel extending along one side, so that it is below the surface of the bar. The feeding movement of the boring-bar shown in Fig. 20 (manufactured by H. B. Underwood & Co., Philadelphia, Pa.) is obtained through planetary gearing. Two changes of feed are provided and the power feed may readily be disengaged. When setting up one of these portable boring-bars, it is centrally located with reference to the cylinder counterbores at each end, because they have not been subjected to wear and are concentric with the original bore. After a cylinder has been bored out repeatedly and the diameter is increased considerably, the original size is obtained by inserting a lining.

Tools for Boring and Reaming Cylinders

One of the most important features of cylinder boring and reaming practice is the kind of tool used for the roughing and finishing cuts in the cylinder bore; in fact, the principal variations in the practice of different manufacturers pertain to the type of cutter or reamer used, especially if the cylinder bores are finished complete by reaming instead of by grinding. In a succeeding number of MACHINERY, a variety of cutting and reaming tools, which have been used successfully in automobile plants and in other shops handling relatively small cylinder work, will be described in an article on "Cylinder Boring and Reaming Tools."

* * *

According to a recent Commerce report the Isle of Pines, Cuba, promises to become an important producer of iron, copper, and other ores. Eleven mines have already been located and two are being developed. The Cuban Government is taking an active interest in the development of these mines.

HIGH-SPEED STEEL PUNCH-PRESS DIES

At the plant of the Robbins & Myers Co., Springfield, Ohio, a great many power-press dies are employed in the production of sheet iron disks used for building up the armatures of various types and sizes of electric motors which are manufactured by this company. Most of these dies are made of high-grade oil-hardening carbon steel which gives very satisfactory results, the average production of a die being approximately 1,000,000 disks. To any man who has had experience in the operation of power presses, it will be apparent that the amount of service obtained from these dies is very satisfactory, and furthermore, virtually no trouble is experienced through breaking of the dies or the necessity of discarding them before they are completely worn out. It is not an uncommon thing in this company's factory to see blanking dies in operation which have been ground down so that they are not over 3/16 inch in thickness. Obviously, the attainment of such results calls for a high degree of skill in the designing and making of dies, and a corresponding amount of care given to the mechanical equipment while in operation.

Recently, the mechanical department of the Robbins & Myers Co. has been experimenting with the use of high-speed steel as a substitute for "Ketos" steel in making these blanking dies. The only reason for considering the change is that preliminary work done with the high-speed steel dies indicates that the production obtained from each die made of this steel will be approximately double that secured from a carbon-steel die, namely, 2,000,000 blanks. Not only is there an advantage in the use of high-speed steel in regard to the total output obtained from each die, but there is also a saving of time, as the dies will last considerably longer between grindings. The method of procedure in making dies from high-speed steel is essentially the same as that followed when carbon steel is used, except in the performance of the heat-treatment. With the high-speed steel, it is found that the most satisfactory method is to pack the finished dies in boxes filled with powdered charcoal, in which the steel is heated to the proper quenching temperature. The only function of the charcoal is to keep air away from the steel so that it can be raised to the high temperature which is required for hardening, without trouble being experienced from scaling and oxidation of finished surfaces of the die. Results obtained from the use of charcoal in this way are said to be better than those secured with a cyanide bath.

* * *

UTILIZING EXHAUST STEAM

One source of fuel waste that may be easily removed, according to *Power*, is the discharging of exhaust steam into the air by small industrial plants. By connecting the exhausts of the engines to the heating systems of adjoining properties, this waste steam can be utilized for heating, permitting the shutting down of the individual heating plants with the resulting saving of labor and fuel. What is termed the isolated block central station is the cheapest, most economical, and most convenient system of heating. That such a plan is feasible has been proved by the success of the central steam heating plants found in a number of cities, which generate steam solely for this purpose.

* * *

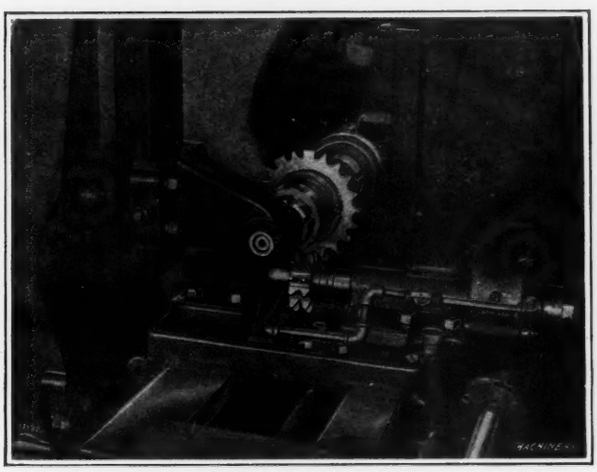
A movement has been started by the Americans in Tientsin, China, to encourage the younger employes in American business houses in that city to study the Chinese language. Americans interested in the import and export trade have long recognized the desirability of getting into closer touch with Chinese merchants, and it is with this object in view that the movement has been started. By the establishment of a language school, the employes of all American concerns are given an opportunity to learn sufficient Chinese to enable them to converse intelligently with Chinese business men on business matters.

UNIVERSAL CUTTERS FOR "DIAMOND" SPROCKET TEETH

Where formed rotary cutters are used for cutting the teeth of spur gears, it is necessary to have a set of eight cutters each of different pitch to provide for cutting gears with different numbers of teeth, ranging from the smallest sized pinion to a rack. It is a matter of quite general knowledge that, in using these gear-cutters, any one cutter can only be used for a certain range of tooth numbers; and although information concerning the methods of cutting sprocket wheel teeth has not been so generally distributed, the same condition applies. In shops having a great many sprocket wheels to cut with any one number of teeth, this need for individual cutters is not a matter of great importance, but to the jobbing or repair shop which has to cut a few wheels of each tooth number over a considerable range, it will be apparent that the investment in cutters required to handle this business imposes a heavy item of expense upon the firm.

In order to overcome this difficulty, the Diamond Chain & Mfg. Co., of Indianapolis, Ind., has developed a universal sprocket wheel cutter for use in cutting the teeth of sprockets with the special "Diamond" tooth form which has been developed by this company. The great advantage of these cutters lies in the fact that for sprockets of a given pitch, one cutter is able to cut successfully the teeth of wheels with any number of teeth. Hence, it is only necessary for the jobbing shop to invest in one cutter for each of the different pitches of sprocket wheel teeth that it is called upon to cut. The following is a brief description of the method of procedure in using one of these cutters on a gear-cutting machine of the type built by the Cincinnati Gear Cutting Machine Co. and others. It will be apparent from the illustration accompanying this description that the cutter is designed to straddle the tooth, instead of to enter the space between two teeth in accordance with the usual practice in gear cutting.

After a cut has been taken over one tooth, the work is indexed through two tooth spaces, this idea being indicated by the condition of the work at a point on the sprocket wheel opposite that where the cutter is shown in operation.

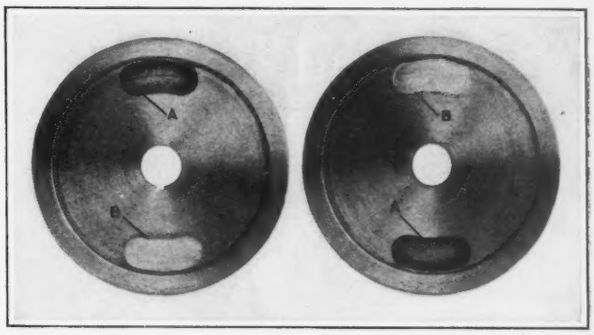


Using the "Diamond" Universal Sprocket Tooth Cutter on a Cincinnati Gear Cutting Machine

Here it will be evident that this double spacing practice has been followed. The reason for employing this method is that, if a practice were made of indexing through single spaces, the cutter would be operating in such a way that at one side it would be removing more metal than at the other side, and hence the pressure of the cut would be unbalanced, thus tending to turn the blank on its arbor and introduce inaccuracies in the form of the teeth cut on the sprocket. It is claimed that with cutters of this type slightly greater accuracy can be obtained in the sprocket teeth than it is possible to secure where cutters of the standard form are used. E. K. H.

BALANCING GRINDING WHEELS

In the September number of *Grits and Grinds* attention is called to the fact that where there is an appreciable amount of vibration in the operation of grinding machines used for snagging castings, the operator is likely to become fatigued more rapidly than would otherwise be the case. This is a particularly important point at the present time when female labor is being largely utilized in metal-working plants. There are various causes for vibration in grinding machines, but one of the most important of these is lack of balance in the rotating parts and notably in the grinding wheel. To overcome this difficulty, the Norton Co., Worcester, Mass., has recently developed what are designated as "balancing



Balancing Flanges developed by Norton Co. for Use on Grinding Machines

flanges," the use of which represents a marked improvement over the practice of balancing wheels by chiseling away some of the abrasive under the flange and filling the space so provided with molten lead. These flanges require no extra space on the spindle, and they serve the same purpose as regular flanges. They are designed with two slots in each flange, one slot *A* being filled with lead while the other *B* is left open. Provision is made for keying the inside flange to the spindle and graduation marks are provided on the outside flange in order that it may be set in any specified position relative to the fixed flange. The flanges are in balance when the lead-filled slot in one flange is opposite the hollow slot in the other flange.

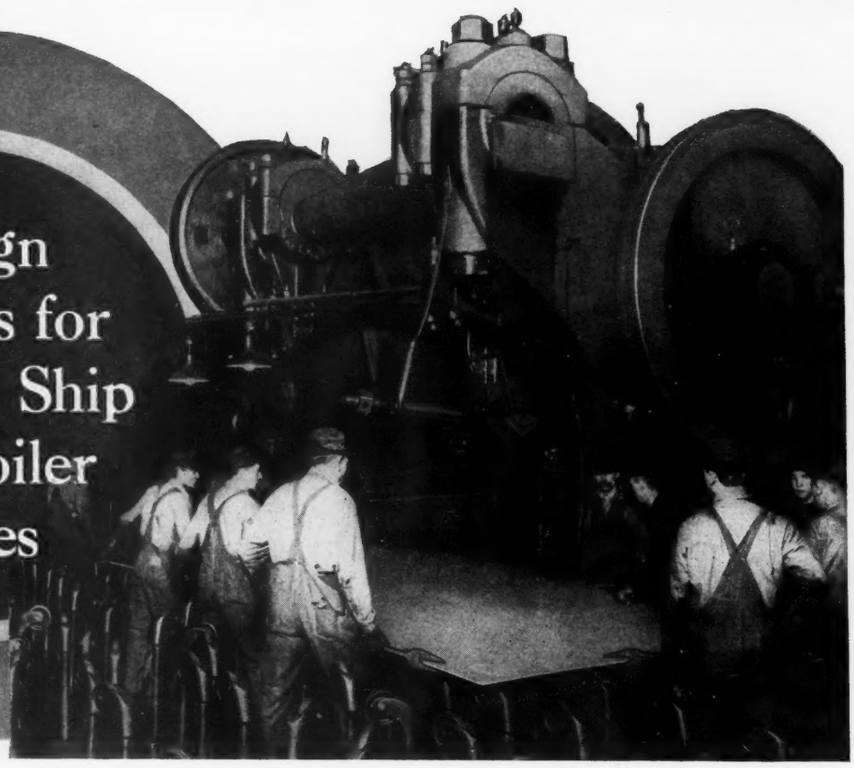
By adjusting the position of the movable flange relative to the one which is keyed to the spindle, a certain lack of balance is created and by means of the graduations this may be regulated to offset any corresponding lack of balance in the grinding wheel. The Norton Co. tests all snagging wheels of its manufacture, and those which are out of balance may be marked with a figure indicating the position of the balancing flanges which is required to effect the necessary compensation. Where this is done, the wheel may be mounted on the grinding machine spindle and the proper graduation of the movable flange set opposite the index mark on the fixed flange, thus assuring an accurate condition of balance for the grinding wheel. As the wheel wears down, the error in balance is likely to change, and compensation for such a condition may be made by simply loosening the nut and moving the loose flange until trouble from vibration is no longer experienced.

* * *

A LARGE HACKSAW

An example of the remarkable progress made in recent years in developing power-driven hacksaws is shown by the equipment of one of the Royal Naval Gun factories in England. A set of five motor-driven hacksaws that will cut hardened bars of gun steel 15 inches in diameter is part of the tool equipment of these plants. A still larger power hacksaw has recently been added to this equipment which weighs 3½ tons. This machine will cut through square billets of steel 26 inches thick, using one blade which is still serviceable after completing the heavy cut. The machine is driven by a 3-horsepower electric motor. It is said that the cost of sawing is only one-sixth of the sawing cost experienced when earlier methods were employed. M. E.

Design of Rolls for Making Ship and Boiler Plates



Photographs in this Article, Copyrighted by Underwood & Underwood

Rolling Mill Practice—Drafts of Slabbing and Plate Mill Rolls—Universal Mill—Surface Speed of Rolls—Rolling Tin Plate

BY S. W. STANDIFORD

THE war created a demand for tremendous quantities of steel plates for making ships and boilers, as well as for thin metal sheets used for general purposes. This demand has taxed the production capacity of every mill in the country to the utmost. Therefore, the solving of the difficult problems encountered in the rolling of sheets and plates is of greater importance than ever before. The term "sheets" is applied to flat pieces of metal such as iron, steel, or the non-ferrous metals which are less than ¼ inch thick. Rolled metal ¼ inch thick and over is called "plates." The term "tin plate" is an exception, and is applied to thin sheets which are coated with tin.

Plates are rolled in various lengths, their dimensions being limited by the railroad transportation facilities. There are two styles of plates on the market—sheared and universal; sheared plates are cut to certain sizes as desired by the purchaser. In all plate mills there is more or less waste of metal due to the shearing of the imperfect edges, the proportion of the plate thus cut to the waste material being clearly greatest in the case of long narrow plates. To avoid shearing anything from the sides of long narrow plates, they are generally rolled in a "universal" mill. Plates as large as 100 feet long, 6 feet wide and ½ inch thick, down to 1 foot wide and ¼ inch thick, are produced in this way. The waste of plates rolled on a universal mill averages about 15 per cent less than that from those rolled on a plate mill.

English Rolling Mill Practice

The length and thickness of plates which a mill can turn out are independent of the dimensions of the rolls, but the width is determined by the length of the rolls; thus a 120-inch mill means that the mill will roll a plate 120 inches wide. Plates can be rolled from ingots or slabs, both giving equally good results in the finished product; they can be rolled in either two- or three-high mills. The English use the two-high system, and it is their usual practice to have a separate set of roughing rolls connected by boxes and spindles to the finishing ones, the rolls being driven by a reversing engine. The reversing engine, however, is not economical to work. In English practice, the ingots were formerly rolled directly into plates without reheating, but of late years the plan has been adopted of rolling the large ingots into slabs of 4 inches or more in thickness; they are then cut while hot into the desired lengths and, when needed, are put into a heating furnace to raise their temperature for the final rolling. More fuel is used by the latter method, but fewer defective plates are made, and there is less strain on the machinery, these advantages being generally considered by English manufacturers to more than compensate for the extra amount of fuel consumed.

On the English plate mill, the same crew does the roughing and finishing, first working the cut slab on the roughing rolls until it is reduced to a suitable thickness and then transferring it to the finishing rolls. Two crews cannot be used on this style of mill, as the jerking and uneven action of the roughing rolls interferes with the action of the finishing rolls, which results in rough surfaces and a lack of uniformity in the gage. In the English system, the rolls are worked dry, no water being used upon them; this necessitates turning the rolls slightly concave in order to allow for expansion. When a mill of this type is first started, it is customary to roll narrow plates until the rolls are gradually heated and expanded to a level surface.

American Rolling Mill Practice

The general practice in this country is to finish sheared plates from ingots or slabs on one stand of rolls without reheating them, the three-high system being employed, and running water used on the rolls to cool them. It may be thought that the use of water on the plates would cool them quickly and interfere with their reduction in thickness, but the water does not cool the plates as much as might be anticipated, because the heat of the plate suffices to maintain the water in the spheroidal state, thus preventing any close contact between the two. The use of water on iron and steel plates during rolling is advantageous, as it loosens the scale. Iron plates while being rolled contain more scale than steel ones. This is due to the fact that iron is more impure than steel, the impurities working out in the form

of scale. The presence of scale on plates is troublesome when rolling, especially when near the finishing stage, because if it is not swept or blown off, it will invariably mark the finished product. When a set of rolls is used for both roughing and finishing purposes, the wear on the rolls from the scale is greater than is the case where a separate set of rolls is used for roughing down the ingot. The result in the former case is that the rolls require frequent dressing if a smooth product is desired. The American system of using running water to cool plate rolls obviates the necessity of turning them with a concave surface, as is necessary in the English system.

When thin plates are to be rolled, the largest output is secured by using a separate stand of finishing rolls, the roughing set being arranged in tandem with the finishing set and connected to it by tables. Each set is driven by its own engine. By this method, the finishing rolls can be run at as high a speed as is practicable, which not only gives a better finish to thin plates but allows a greater output. The work of the roughing rolls can be so distributed as to synchronize the time cycles of the roughing and finishing mills.

One of the generally used types of plate mills is the Lauth mill. This is a three-high mill with one stand of rolls. A unique feature of this mill is the manner in which the middle roll is used to support the top and bottom rolls when they are in action. The top and bottom rolls are 34 inches in diameter and run loose; they are raised or lowered by a hydraulic cylinder to enable the plates to enter between the middle and top rolls and between the middle and bottom rolls. The middle roll is smaller in diameter than the other two.

As it is desirable to make the slab of an even width, it is inserted diagonally in the rolls with one corner facing upward; this reduces it to a diamond shape. It is then turned over and entered on the opposite diagonal corner, the result being that the second reduction again squares the slab. If necessary, this operation is repeated several times, depending upon the hardness of the steel. The slab rolled by this method has a uniform width. The rolling is now resumed in the usual manner until the plate has been reduced to the desired gage.

Design of Blooming Rolls

Fig. 1 shows a set of blooming rolls having a slabbing pass. Rolls of this type are in general use in this country as well as in England. They are used for reducing large ingots, the latter being worked in the slabbing pass until they are sufficiently narrow to enter one of the edging passes. The ingot by this time is reduced to a long rectangular shape. The rolls are then raised and the metal is inserted into one of the edging passes, narrow edge upward, and rolled to the desired size. In order to have the edges of the finished plates as free from cracks as possible, it is necessary that the ingot be worked on all four sides, as the action of the rolls makes the metal fibrous in nature, which is the object desired by all iron and steel manufacturers. The slabbing or blooming rolls shown in Fig. 1, have the slabbing pass bottom put in level, which is the case in rolls used in most blooming mills; in some cases, however, the roll designer puts in a curved slabbing pass, the highest part being in the center. This design makes a most excellent working pass which does not strain the machinery as much as a groove having a straight bottom.

As the ingots in a blooming mill are turned over at right angles to their previous positions in each successive rolling operation, the two concave sides produced by the convex surface of the slabbing pass are straightened. One advantage of having a concave surface rolled on the edges of the ingot by the slabbing pass is that it prevents the edges from bulging out and forming a convex surface when being rolled between the reducing rolls, which is the case where straight rolls are used to face the edges of the ingot. The importance of this feature is realized when it is understood that great difficulty is often experienced in facing the edges of an ingot which has been put through a straight slabbing pass, as the bulged edges make it difficult to enter the work and keep it in an upright position between the rolls. In the case of ingots having concave edges the effect is opposite, as they facilitate the entering of the work in the finishing rolls, and tend to locate and maintain the ingot in an upright position. Another advantage of the curved surface on the rolls is that the metal can be very quickly dragged into the roll. The merits of curved passes for this class of rolls are of the utmost importance, and they give excellent results under actual working conditions in the average mill.

Drafts of Slabbing and Plate Mill Rolls

Slabbing and plate mill rolls depend mostly for their drafts on the amount of up and down play which the housings permit, it being in the roller's power to use either light or heavy drafts as is considered necessary. The usual practice is to reduce the steel as quickly as possible while it is hot by the use of heavy reductions in rolling. Many rollers, in their eagerness to get their day's work done as soon as possible, abuse the rolls and machinery by reducing the metal to the utmost possible limits which the rolls and apparatus will stand; thus, there is danger of breaking the rolls, roll necks, or wobblers as well as damaging the housings and engines. When too heavy drafts are being taken, a cloud of black dust arises from the rolls while they are in action; this is an infallible test. The black dust coming from the surface of the rolls shows that they are being ground off by the hot ingot metal. Rolls roughly handled by the roller require the removing of an extra amount of metal by the roll turner when dressing them, in order to bring the passes into shape again, and this extra metal is therefore wasted. It is much better to work this class of rolls at the maximum safe rate of reduction that they will stand, and at a steady even pace without interruption from breakdowns than to

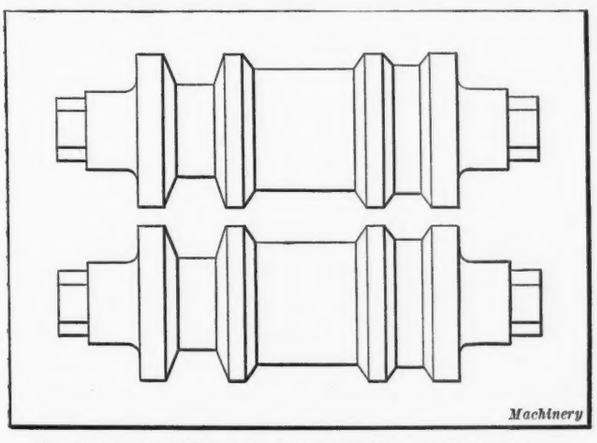


Fig. 1. Blooming Mill Rolls having Slabbing and Edging Passes

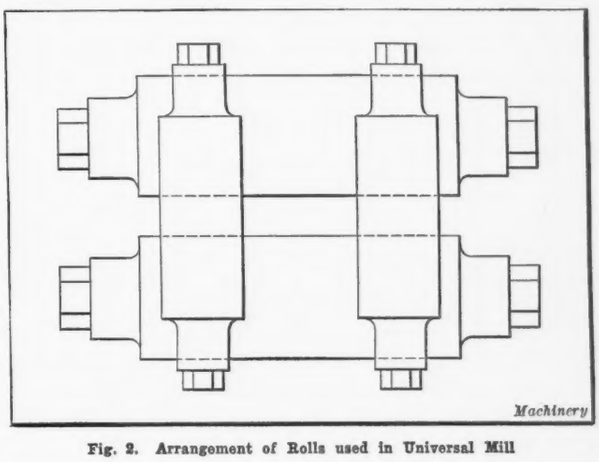


Fig. 2. Arrangement of Rolls used in Universal Mill

make a spasmodic effort to break tonnage records, and thus strain the machinery, causing a shutdown sooner or later for repairs. Excessive reductions also produce plates that are thicker at the center than at the edges.

Universal Mill

A type of mill also much used in this country for plate making and jobbing work is the universal mill. This consists of a pair of ordinary plain cylindrical rolls mounted in the usual way, at the back of which a shorter pair of similar rolls are mounted with their axes in a vertical position, so that they will compress the edges of the bar at the same time that the horizontal rolls compress it on the flat sides. This arrangement obviates the necessity of the ingot having to be turned over on its side so as to work the edges that face the joints between the surface of the rolls, as is the case with slabbing rolls.

The vertical rolls, which are usually smaller in diameter than the horizontal ones, are generally driven from the upper ends by means of miter gearing connecting with a shaft that crosses the tops of the housings. Originally, the vertical rolls were driven from the bottom ends, but scale from the steel being rolled fell into the gearing and caused the teeth to wear out so rapidly that they are now all driven from the top.

Fig. 2 shows how the rolls are placed in a universal mill, no gearing being shown. It will be seen that by the combination of four rolls any width and thickness of flat plates within the range of the mill can be rolled with equal facility. Universal mills generally roll plates up to 6½ feet wide.

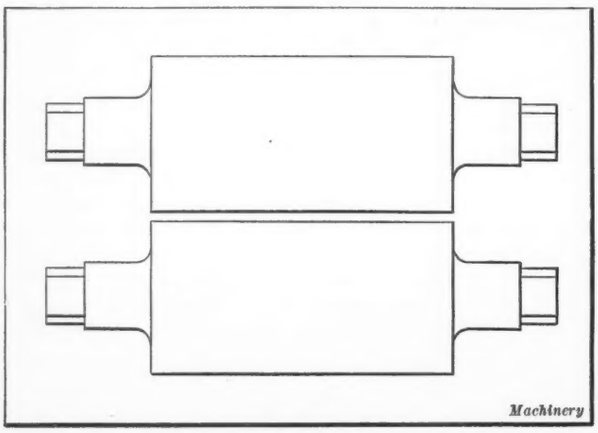


Fig. 3. Tin-plate Roughing Rolls

It is customary to straighten the edges of the plates that are rolled in these mills by pressing them while they are hot between two bars which are squeezed against the plates laterally.

Effects of Uneven Heating

If the piece rolled in a universal mill is not entered perfectly square, or if it bears much harder on one vertical roll than on the other, it will be curved in a horizontal direction. The same thing occurs if the plate is not evenly heated, as the hotter side elongates more than the colder one, and, once bent, it is not easy to straighten. The effect of uneven heating on the working of the steel in the rolls, therefore, shows in the finished product. It is of great importance that the material be uniformly heated. Unevenly heated and crooked plates give much trouble in turning and in handling, and their thickness varies in different parts due to the hot and cold spots in the plate. When the outside of a plate is cold and the center hot, the rolls are sprung and the housings stretched appreciably; hence if one end of a long plate is much colder, it will be thicker than the other when it leaves the rolls. This is a constant source of trouble with thin plates and strips, which cool so rapidly that the end passing through the rolls last is always colder and therefore thicker than the entering end.

Surface Speed of Rolls

On the universal mill, the surface speed of the vertical rolls at the back must be greater than that of the horizontal rolls through which the bar has passed by an amount depending upon the extent to which the top roll is screwed down at each pass. If the surface speed of the vertical rolls is too low the bar will not be passed on as fast as it is received, and if thin, it would be crumpled between the pairs of rolls and spoiled. To avoid this, the vertical rolls must always be run somewhat faster than is theoretically required. As it is impossible to guard against a workman putting on too much draft at a pass, this speed must, in practice, be considerably in excess of the correct amount. This has the disadvantage of causing slipping of the edges of the bar on the surface of the vertical rolls, wearing the rolls out rapidly, absorbing much power uselessly, and causing considerable backlash, which is destructive to the gearing. Even if the surface speed of the two sets of rolls is correctly proportioned when the rolls are new, the relation is destroyed as they are turned down to correct for wear.

The horizontal rolls are generally driven by a reversing engine, while the vertical rolls are driven by a second set of similar engines of less power. The universal mill is not an easy one to work, much skill being required on the part of the man who adjusts the rolls in order to keep the mill working smoothly.

Rolling Tin Plate

In the rolling of tin plate, which is chiefly made from semi-finished steel bars, there is a loss of metal in the heating and rolling from the semi-finished to the finished form of from 6 to 8 per cent. The bars from which these plates are rolled, are 8 inches wide, and vary in thickness from ⅜ to ½ inch, the length varying according to requirements. Rolls for making tin plate are generally shorter than those that roll heavier plates.

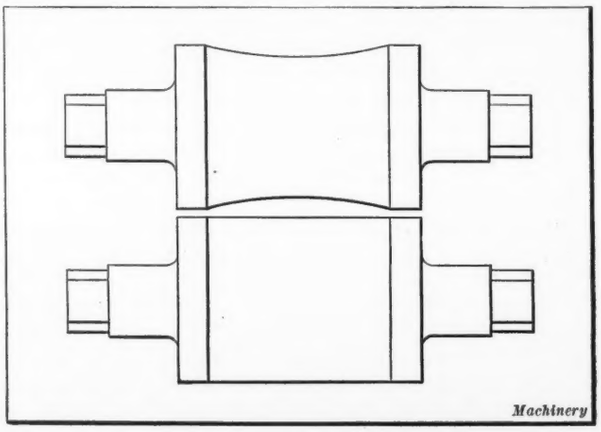


Fig. 4. Finishing Sheet Rolls

Fig. 3 shows tin-plate roughing rolls, which are turned straight throughout their length and are used to break down the tin plate to a suitable thickness so that it can be reduced quickly in the finishing rolls. The metal being rolled is so thin that no water is used on the rolls and for this reason one of the finishing rolls is turned with a concave surface, as shown in Fig. 4. Narrow sheets are rolled until the center of the roll that has been turned concave is expanded by the heat so that it becomes straight, after which wide sheets are rolled. Both the finishing rolls could be turned with a concave surface, but it is found advisable in practice to turn one roll with a plane surface and double the amount of concavity in the other roll.

After the roll with the plane surface is turned, the roll that is to have a concave surface is put into the lathe. Then the one turned straight is held in a fixture in the carriage above the other roll and in such a position that the axes of the two rolls are out of line, or crossed. This brings the middles of the rolls nearer each other than the ends.

Fig. 5. Ingots as they are received at the Rolling Mill, Ready to be rolled into Plates

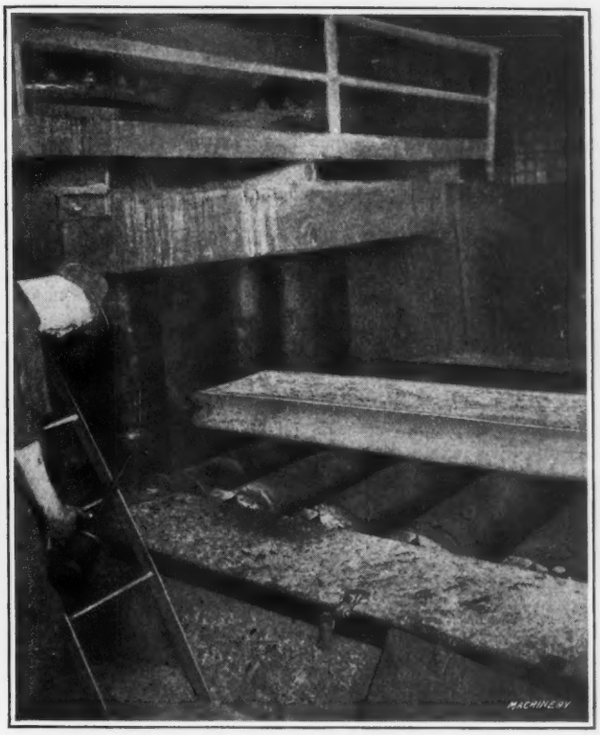


Fig. 6. Rolling Ingot into Shape before flattening and cutting into Billets for Plate Making

The rolls are placed as close to each other as is practicable without touching. Narrow cuts are then taken in the lathe from the center of the bottom roll until it has a curved surface, the top roll being let down on it from time to time, until no light can be seen between the two when they touch.

The amount that the rolls are crossed in the lathe when turning the concave surface varies with their length and diameter. The usual amount of crossing is as follows: Rolls 24 inches in diameter by 32 inches long should be crossed 2¼ inches at the ends. Rolls 38 inches long and 24 inches in diameter should be crossed 2½ inches at the ends. Rolls 24 inches in diameter by 40 inches long should be crossed 2⅝ inches. Rolls 48 inches long need not be crossed more than 2⅝ inches, as the wide sheets rolled by such long rolls are not worked as fast as narrow ones, hence the rolls do not become heated so rapidly.

To obtain the best results in rolling thin sheets the top roll should be 2 inches smaller in diameter than the bottom one. As the top roll has a smaller diameter, it bites deeper into the pack of sheets, and as it has a slower rate of surface speed than the bottom roll, the sheets will lie flat and open up more easily.

Temperature for Working Sheet Rolls

Sheet rolls should not be worked at too high a temperature as they are likely to crack; in fact, many sheet mill rollers

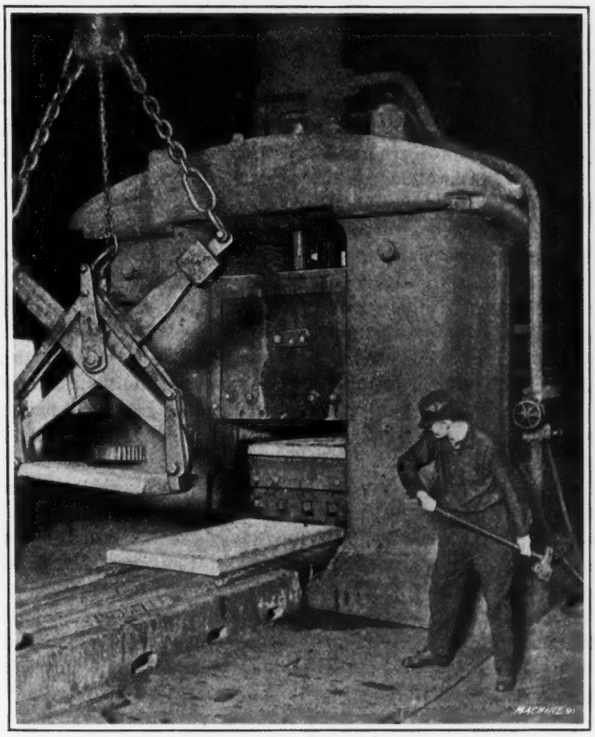


Fig. 7. Shear for cutting a Flattened Ingot into Billets

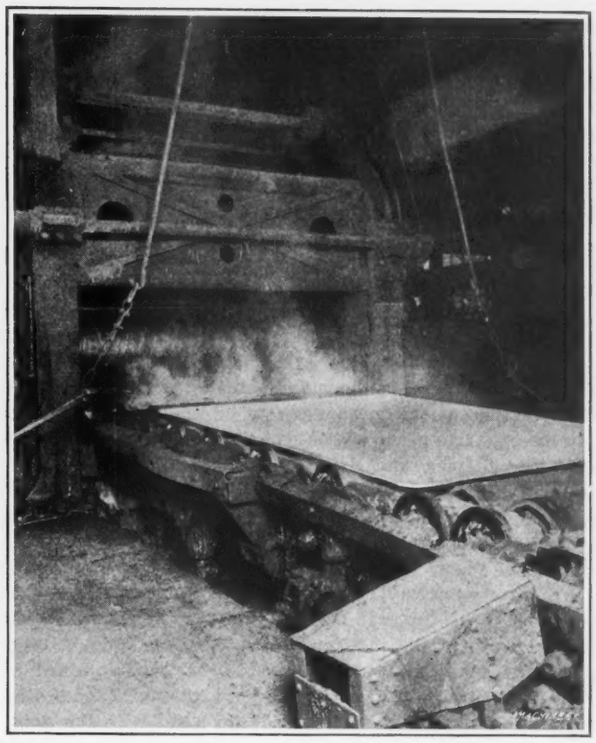


Fig. 8. Steel being rolled into Plate for Shipbuilding

crack the rolls by working them at too high a heat. The best rolls will be cracked by heating them too suddenly, and by having the ends vary too much in temperature from the centers. Rolls once cracked, soon break in two. When the rolls have a deep blue color in the center, while the ends are purple, the centers are known to be at about 600 degrees F. This is the highest temperature that they should be allowed to attain, as at higher temperatures the rolls are almost certain to break or to develop fire cracks; the surface becomes burned or rough and pieces break out.

There are two important points in the rolling of thin sheet steel that the roller has to consider; the first is to make the pack of plates open easily, and the second is to make them lie flat when finished. The second is more difficult, for to make a heat of sheets lie perfectly flat is not an easy thing to do. The roller may operate the adjusting screw in exactly the same manner on each pack of sheets and yet each one will have a different shape when finished; one sheet will dish, another pack of sheets will buckle, and other sheets will draw to one side even though made in the same heat.

Uneven heating in the furnace will cause the pack of sheets, while they are in the rolls, to run off to one side. The heater often places the packs in the furnace and when partially heated, turns them up on their edges; the sides of the pack are then upward and in the open part of the furnace, this side being more exposed to the heat and flames than the side on the bottom of the furnace. One side or edge of the pack thus acquires a greater temperature than the other, which may vary from 25 to 50 degrees. When an unequally heated pack is inserted into the rolls, the hot side or the side in which the temperature has been raised above the other, will pull faster than the other. This causes the sheets to move or shift their position on one another and to pinch, buckle, and show stress marks. If the metal is heated too much in the furnace it will cause a large amount of scale. If the rolls are worn slightly hollow in the middle (which is generally the case toward the end of a week's run), the scale will be pushed along toward the center of the plates and be embedded in the metal, which causes trouble in the pickling department, as the pickling fluid will eat into the metal long before the scale is removed. This never occurs when the sheets have little scale on their surface.

From the foregoing, it will readily be seen how important a part the correct heating temperature plays in the manufacture of tin plates, especially when the rolls are worn slightly hollow in the center, which is always the case when the rolls are changed only once a week. To the uninitiated person who looks at a sheet metal crew at work, the manufacture of thin sheets looks simple and easy; but unless the heater and crew work with the foregoing points in mind, there will be many spoiled sheets which have various imperfections and which will not be accepted by the consumer.

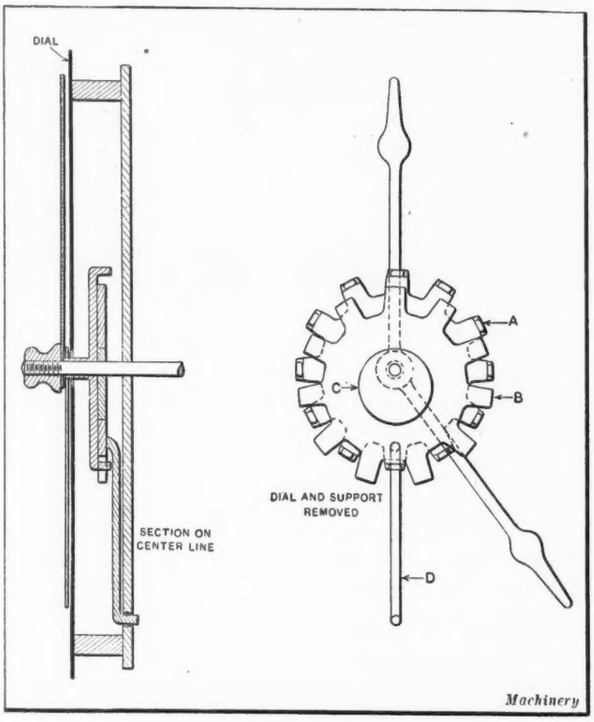
* * *

TWO-GEAR REDUCING MECHANISM

In the design of mechanisms in general, eliminating useless parts and obtaining the desired result by using the most simple and direct means is often the most essential part of the problem, especially when even a single unnecessary part would greatly increase the manufacturing cost. The interesting feature of the mechanism to be described is that it contains only two gears which give the same speed ratios between the driving and driven members as are ordinarily obtained with a train of four gears. One application of the mechanism is to clockwork or time-pieces. The hour hand of an ordinary clock is driven through a compound gear train, called "dial gears," which serves to turn the hour hand one-twelfth revolution while the minute hand makes a complete revolution. The two-gear mechanism which is shown on an enlarged scale in the illustration, enables the same 12 to 1 ratio between the minute and hour hands to be obtained.

The hour hand is attached to a gear *A* having 12 teeth, the ends of which are bent so that they lie parallel to the axis, similar to a crown gear. Within gear *A* there is another gear *B* which has 11 straight or radial teeth. This inner gear is mounted on an eccentric *C* attached to the shaft for revolving the minute hand. As this shaft turns, the eccentric causes the axis of gear *B* to revolve, but the gear does not turn about its own axis, as there is a rod *D* which prevents such movement. The lower end of this rod is bent at right angles and engages a slot, thus allowing the planetary movement of gear *B*, but preventing it from revolving about its own axis.

Each revolution of the minute-hand shaft and eccentric, causes the teeth of gear *B* to withdraw from whatever tooth spaces of gear *A* they happen to be in mesh with and engage the next successive tooth spaces; consequently, gear *A* is advanced an amount equal to one tooth or one-twelfth revolution for each complete turn of the eccentric and minute-



Two-gear Reducing Mechanism

hand shaft. In this way, the desired speed ratio between the minute and hour hand of a clock is obtained. Of course, this speed ratio might be varied to suit different requirements. This mechanism is not intended only for clockwork, but can be applied wherever a simple reducing device is required in mechanisms of the type used in connection with counting and recording instruments.

The relative positions of the driving and driven parts during any fractional part of a revolution depend upon the length of the rod *D* attached to gear *B*. If this rod were of infinite length, a uniform rotation of the eccentric shaft would cause the driven part also to revolve at a uniform rate; but with rods of ordinary length, the motion of the driven part (which, in the case of a clock, is the hour hand) is accelerated and then retarded as it moves from one figure to the next on the dial. If rod *D* were dispensed with and gear *B* prevented from rotating by a pin attached to some point within the gear teeth, and engaging a fixed slot as in the case of rod *D*, the driven part would remain nearly stationary during a large part of the driver's revolution, and the movement from one division point to the next would be quite rapid. This rapid motion would be desirable for counting mechanisms in order to have the indicating hand opposite the numbered divisions, except when rapidly moving from one position to the next successive number on the dial. This two-gear speed-reducing device was designed by Albert L. Colburn, 159 Westwood Road, New Haven, Conn. F. D. J.

PROSPECTS FOR READJUSTMENT OF THE GEAR BUSINESS

BY F. W. SINRAM

Vice-president, The Van Dorn & Dutton Co., Cleveland, Ohio

IN passing through the transition period during which war-time conditions of industry must be changed over to a normal basis of operation, the gear industry will have to solve many important problems. Among these, particular attention will have to be paid to the question of war-time inventories and the effect which these will have upon the future prosperity of plants which are now receiving cancellation of government orders. It is quite apparent to anyone who is familiar with the accounting practice of industrial plants that the large stocks of raw materials which it has been necessary to accumulate at abnormally high prices, have been entered upon inventory lists in such a way that the books of many plants show "paper" profits which are never likely to be actually converted into cash.

Much of the accumulation of raw materials which has taken place during recent months, has been made with the view of expediting the execution of government orders, or the production of gears which are destined to go into products ordered by the Government. The purchase of these materials was largely a patriotic duty performed against the better business judgment of those in charge of the plants. Consequently, it seems eminently just to expect that the Government will make some modification of the existing war profits tax which, if rigidly enforced in its present form, will place a most severe burden upon many manufacturers who find themselves in a somewhat serious predicament as a direct result of the patriotic zeal with which they have carried on their work of producing gears required for use in military and naval equipment. One adequate method would be to allow manufacturers to make a deduction from their apparent profits for the past year in order to compensate for the deflation of inventory values. It would, of course, be necessary to protect the Government against abuse of such a privilege of deduction, but this could be accomplished by proper methods of inspection or appraisal, and by fixing a maximum percentage of deduction to be allowed.

Proposed Method of Procedure by the Government

Under date of November 29, 1918, a statement was issued by Secretary Baker which shows that the Government has this general proposition under consideration. The statement referred to reads as follows: "To prevent too violent dislocation of industry from the standpoint of both employe and employer, accummulation by the War Department of either raw material or finished products will be distributed when and where liquidation of such supplies will least interfere with the return of industry to normal conditions." This measure, if properly carried out, will do a great deal toward protecting the market for materials, but in addition it would seem that some more definite provision should be made for safeguarding the interests of manufacturers who, according to the present law, will have to make their tax returns for the year upon a basis which is likely to seriously handicap their ability to resume normal conditions of operation.

Importance of Prompt Settlement of Contracts

Another point of vital interest to manufacturers in the gear business, as well as other lines of industry, is prompt and equitable settlement of outstanding contracts by the Government. Manufacturers have large sums of money tied up in material and in other obligations incidental to the execution of war-order contracts. These obligations can be met without a serious dislocation of industry providing the Government liquidates its outstanding debts on such contracts without unnecessary delay. In the interests of the contractors, of labor which depends upon them for employment, and of the business firms with which they have transactions, it is of the utmost importance for manufacturers to have their capital rapidly brought into a liquid form so that they can enter new business engagements without delay. The acceptance of a policy of prompt settlement by the Government is one of the big steps toward a speedy readjustment of industry to a peace basis.

Good Prospects for Future Business

With proper cooperation from the Government, there is every reason to believe that most plants specializing in the manufacture of gears will continue to receive a satisfactory volume of business. Many indications point in this direction. For instance, the war has shown conclusively that motor trucks afford a highly efficient method of transporting materials, and the favorable notice which they have received in this way will doubtless lead to an increase in the amount of factory capacity that will have to be devoted to truck manufacture, in order to supply the demand from private users. Publicity secured in this way appears to have assured future prosperity for builders of motor trucks, that is, if the proper highways are provided. By this is meant the reconstruction of roads now in poor shape as a result of heavy hauling to an extent not heretofore anticipated, and the construction of new roads. In this connection it is pointed out that the use of motor trucks in solving the "short haul" problem of the railroads, which was adopted as a war-time measure, will be continued as a permanent method of transportation. Good conditions of business for the builders of passenger cars is also predicted by several of the leaders in the automobile industry.

Those who are in the best position to know of conditions in Europe state that no solution of the food question can be hoped for until next year's harvest is available. They also emphasize the fact that much of the political unrest in Russia and elsewhere is due to unemployment of considerable percentages of the population of those countries. Granting the accuracy of the assumption that shortage of food and unemployment are two of the most serious causes for discontent, it is safe to assume that the provision of agricultural machinery for the people to use in cultivating the soil would be one important method of correcting the actual causes of disorder. It is on this assumption that the prediction is made that American builders of agricultural machinery will do a good export business to Europe.

The Gear Industry—a Barometer of Business

The cases cited are merely a few typical examples, but they have been mentioned because gears are used in all of the classes of equipment built by the industries to which reference has been made, and so business obtained from any of these sources means not only activity in the shops of gear manufacturers, but also in other plants which employ a far greater number of industrial workers. To carry on the work of all of these plants, a demand is created for the products of steel mills and other industrial plants engaged in the production of raw materials. In a sense, therefore, the gear industry may be regarded as a barometer of business conditions in the mechanical industries; and at present there are many indications that this barometer will continue to show a satisfactory level of business prosperity.

* * *

The Colorado Industrial Commission has recently reduced the amount of compensation awarded a workman in a case where death resulted from accidental burning. The reduction to 50 per cent of the amount originally allowed was decided upon because it was found that the accident occurred when it might have been prevented by obedience to a safety rule which was violated by the workman.

JANUARY, 1919

MACHINERY

VOL. 25 NO. 5

Published Monthly by
THE INDUSTRIAL PRESS
140-148 LAFAYETTE ST.
NEW YORK

ENGLAND
51-52 CHANCERY LANE
LONDON

CABLE ADDRESSES
MACHINERY, NEW YORK
MACHTOOL, LONDON

ALEXANDER LUCHARS, President
MATTHEW J. O'NEILL, Treasurer
ROBERT B. LUCHARS, Secretary

EDITORIAL
ERIK OBERG, Editor
FRANKLIN D. JONES EDWARD K. HAMMOND
Associate Editors

THE IMPROVED CONVENTION

In the past, conventions were often mere social gatherings, but many of the conventions held during the past year, by manufacturers and other business men, have forecast a definite and very important change in their functions—and results. The National Machine Tool Builders' convention held in New York in December was decidedly along the new lines. Important commercial questions were dealt with in a serious and business-like manner, and the same is true of the conventions held by the American Gear Manufacturers' Association during the past year. The proceedings of the notable conference of American manufacturers and business men held at Atlantic City early in December—the Reconstruction Congress—also showed that serious thought is now being given to the important commercial problems that occupy the public mind at this time. At each of these conventions, the greater portion of the time was devoted to committee meetings, where the members concentrated on specific problems and worked out important policies. Much less time was given to general speech-making than formerly, and those who attended returned home with a feeling that something definite had been accomplished.

It is reasonable to predict that this change in convention procedure will be permanent, and that the work of conventions will in the future be regarded with greater seriousness. There is a far better opportunity for the exchange of ideas among men engaged in the same industry when they confer in small specialized committees than when they meet only at large general gatherings. Much time was formerly wasted in general discussions that led nowhere. The more direct, practical, and efficient methods now being employed to obtain and apply the opinions of practical men who meet in conventions mark a distinct step in advance.

* * *

WASTEFUL DETAIL WORK OF EXECUTIVES

A prominent machine tool manufacturer recently ascribed much of his success to his policy of delegating all detail work to subordinates, while keeping sufficiently in touch with the various departments to be thoroughly familiar with their work and progress. This practice, he said, gave him an opportunity to think over important problems which he would have had no time to consider had he attempted to handle some of the details himself. He does not consider it necessary to answer correspondence personally, quote prices, make estimates, or take an active part in any of the detail work of his business; but he is always available to employes who want his advice about any details that it is their business to handle. He finds that many of the ideas which have stimulated the growth of his business came to him while sitting at his desk without any definite work to do, but with time to think. He is thus able to visualize at will the complete work of his organization.

Some departments, on account of their importance, require closer attention than others, and in the opinion of this successful executive, one of the most important is that of advertising and publicity, this being the contact point between the business and the buyers of its product. This executive believes in carefully planned publicity because he has found it essential in building up his business—both the sales department and the manufacturing organization; and the success of his business confirms the accuracy of his opinion.

* * *

HEALTH OF THE INDUSTRIAL ARMY

War conditions have brought managers of industrial plants face to face with a difficult problem. As long as industries developed normally, the growth of the communities where they were located was also normal, so that housing facilities for industrial workers kept pace with industrial growth. But the demands of the war have obliged manufacturing plants in some places to increase the number of their employes to such a tremendous extent that housing facilities have become utterly inadequate for taking care of the sudden influx of workers. Cheap tenements, sometimes no better than mere shacks, have been erected, which are not only unsatisfactory as homes, but also a serious danger to the general health of the community, because of the unsanitary living conditions imposed upon those whom they shelter. If the health of our industrial army is to be impaired in this way, there is grave peril ahead for our industries, and for the country.

This state of affairs makes it vitally important for every industrial enterprise which increases its capacity to take steps for housing its employes satisfactorily. A regular system of inspection should be instituted, with a view to insuring sanitary conditions and healthful surroundings for the workers. These matters must not be left to take care of themselves; such a policy might easily prove disastrous. Men and women, to be efficient workers, must be well housed.

* * *

SCRAPPING WORN OUT MACHINES

Many of the munition contracts placed with American manufacturers during the past four years were accepted at prices which were based on the belief that the severe conditions of service would make it necessary to scrap the machine tools and other factory equipment when the work was completed. In many cases machine tools used for munition work have been run night and day, with very little time allowed for making necessary adjustments and repairs, and by operators who had no previous knowledge of machine shop practice. As a large percentage of these machines are in such poor condition as to be unfit for accurate work, it is assumed that they will be sold as junk, and many consider it to be the duty of manufacturers who intend selling such discarded machines to first actually convert them into scrap metal, so that the market may not be glutted with inaccurate, inefficient, worn out second-hand tools really intended for the scrap pile. General observance of this policy will greatly help our enlarged machine tool industry to keep its factories and labor employed, and will effectively aid in maintaining accuracy and efficiency in shop operations.

The New Outlook for Foreign Trade

WHEREVER American manufacturers and merchants gather in conference or convention, the chief topic of discussion today is the future of our foreign trade. For it is conceded by all that American industry has expanded far beyond the capacity of the domestic market to absorb its great and varied products, and must look to foreign countries for the wider markets which have become so important as to be indispensable.

Americans, generally speaking, have sadly neglected their opportunities to sell in foreign countries, but that is an old and oft-told story. A new, and doubtless a brilliant, chapter is soon to be written—under the guidance of old Mother Necessity. There is to be a new attitude toward foreign trade. It is going to be recognized that all trade is simply an exchange of products, and the greater the volume of exchange, the greater the prosperity of a nation. The ships that carry our goods to Europe must come back to us laden with the products of other lands. Trade is trade, and each trader is made richer by the products which embody the peculiar genius of the other. That is a broader view, and an absolutely necessary one to take if we are to develop foreign markets and successfully employ our new merchant marine.

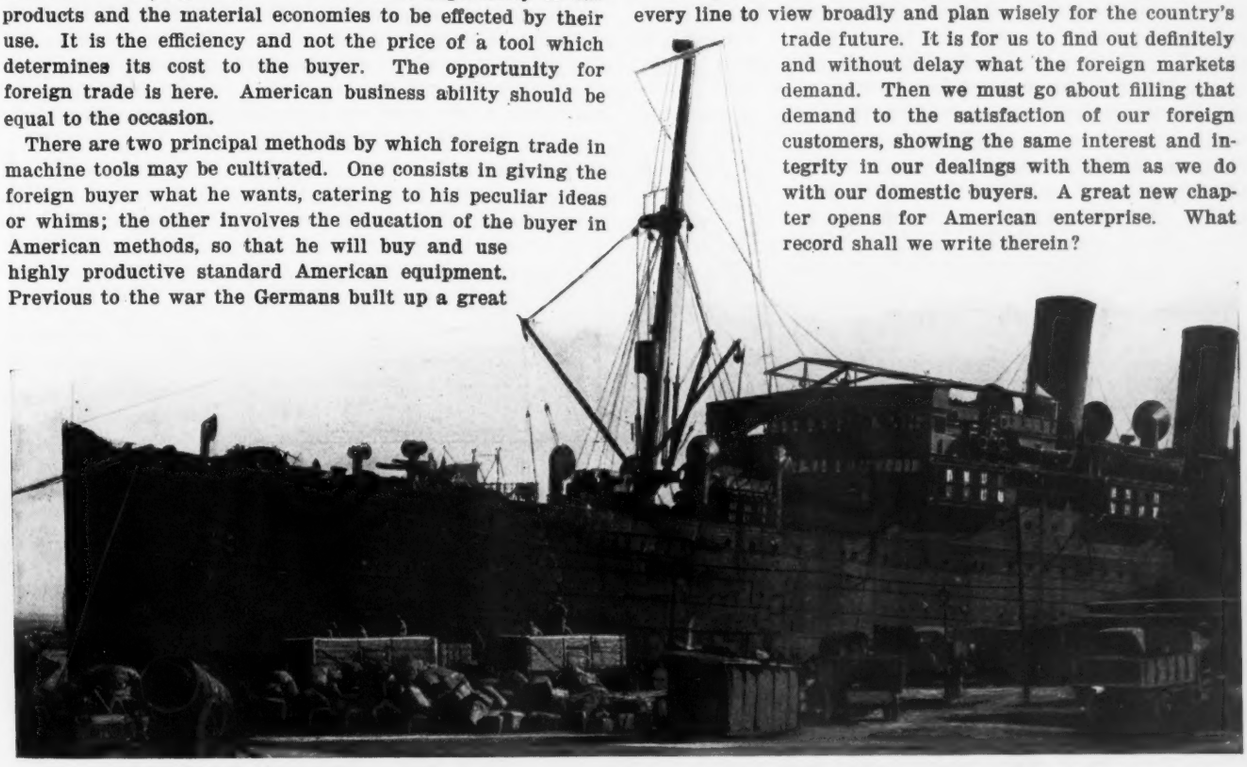
Foreign trade in machinery, and in machine tools in particular, is destined to become of paramount importance if American manufacturers now take full advantage of their opportunities abroad. No one would deny that in the design and manufacture of labor-saving machinery of all classes America has led in the past, and there is no reason for the slightest doubt that America will continue to lead in this line of manufacture. The chief problem is how to convince the foreign buyer of the definite superiority of our products and the material economies to be effected by their use. It is the efficiency and not the price of a tool which determines its cost to the buyer. The opportunity for foreign trade is here. American business ability should be equal to the occasion.

There are two principal methods by which foreign trade in machine tools may be cultivated. One consists in giving the foreign buyer what he wants, catering to his peculiar ideas or whims; the other involves the education of the buyer in American methods, so that he will buy and use highly productive standard American equipment. Previous to the war the Germans built up a great deal of their foreign trade along the first of these lines. They catered to the preconceived ideas of the foreign buyer, giving him what he thought he wanted, often without regard to whether the special designs and devices desired meant real economy to him or not. Foreign dealers are apt to endorse this method—it is the line of least resistance. But such methods do not build up a permanently successful trade.

The American idea has generally been to supply standard machine tools of proved efficiency instead of special tools built at greater expense. It is likely that foreign trade in American machine tools will be built up along these lines. We will send abroad salesmen who, being also engineers, can show the foreign buyer why it is to his advantage to buy the equipment which long and successful manufacturing experience, and careful study by American machine tool builders, has proved to be the best.

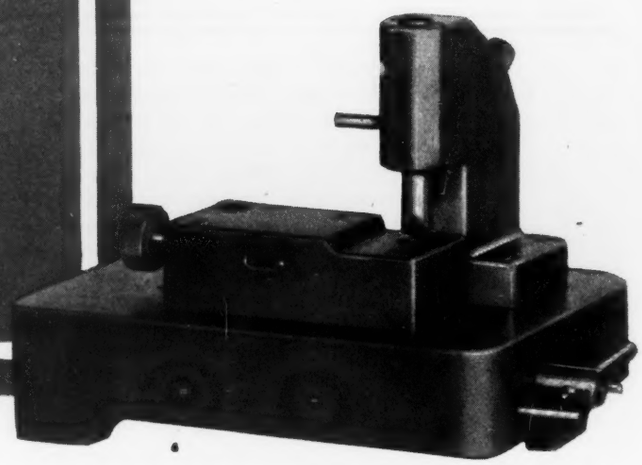
The shipping situation is of the greatest importance in its relation to foreign trade. America is creating a great merchant marine which, if properly handled, will be of tremendous service in the building up of our foreign commerce. The experience of England and Germany previous to the war indicated that the possession of trade routes and shipping facilities was the greatest promoter of foreign trade—greater in fact than any other single factor. Hence it is of prime importance that the future of the great merchant marine now being built be properly safeguarded and its operation placed in efficient hands. It is hardly likely that the Government will continue to operate this enormous fleet of merchant ships, but it is possible that the Government may retain ownership in the vessels, while private capital will undertake to operate them in an efficient manner.

The leading concerns in the machine building field view the future trade possibilities of the United States with satisfaction. They believe that if the opportunities now presented are grasped with characteristic American energy and determination, the United States will secure its full share of foreign trade. It is the patriotic duty of our people in every line to view broadly and plan wisely for the country's trade future. It is for us to find out definitely and without delay what the foreign markets demand. Then we must go about filling that demand to the satisfaction of our foreign customers, showing the same interest and integrity in our dealings with them as we do with our domestic buyers. A great new chapter opens for American enterprise. What record shall we write therein?



Photographs © Underwood & Underwood.

Flush-pin, Sliding Bar and Hole Gages



Fourth of a Series of Articles Describing Principles Involved and Procedure Followed by the Pratt & Whitney Company in Developing Gaging Systems for Interchangeable Manufacture

BY ERIK OBERG

FLUSH-PIN gages are largely used for tolerances that are not less than 0.002 inch, especially in cases where snap gages cannot be conveniently applied. The simplest type of flush-pin gage is that shown in Fig. 1. A hexagon handle is provided in which a pin known as the "flush pin" is inserted. The hole in the hexagon handle is provided with a shoulder and the pin inserted in it is also provided with a shoulder, so that a spring, as indicated, can be inserted between these shoulders, to keep the end of the pin that is in contact with the work in the outward position. A small dowel-pin is driven through the handle and fits into an annular recess cut around the pin. The dowel-pin permits a limited movement of the flush pin but prevents it from falling out of the handle. At the right-hand end of the handle, as shown in Fig. 1, there are two ground steps. When the gage is used, the right-hand end of the flush pin must come beyond the lower step but must not pass beyond the high step on the end of the hexagon handle. These steps, therefore, indicate the limits on the work and the difference between them is equal to the tolerances permitted. The gaging is generally done by the sense of touch, the gage being applied to the work and the position of the end of the flush pin with relation to the steps on the handle being determined by passing the finger over the end of the gage.

It was mentioned that flush-pin gages are generally used for tolerances that are not less than 0.002 inch. It is possible, however, to use them for smaller tolerances, but it is seldom practicable in that case to depend upon the sense of touch, but the use of a straightedge, laid over the end, is generally necessary, and the gage must be held up against the light; hence, the use of a flush-pin gage for tolerances so small that a straightedge must be employed is not generally recommended.

Fig. 1 (and also the view to the right in Fig. 3) shows the simplest application of the flush-pin principle and indicates how flush-pin gages may be made for measuring the depth of holes and recesses. Three standard sizes, as indicated, are made of gages of this design, according to the general practice of the Pratt & Whitney Co. The flush pin is made 0.001 or 0.002 inch smaller in diameter than the diameter of the hole. It is made from drill rod and is

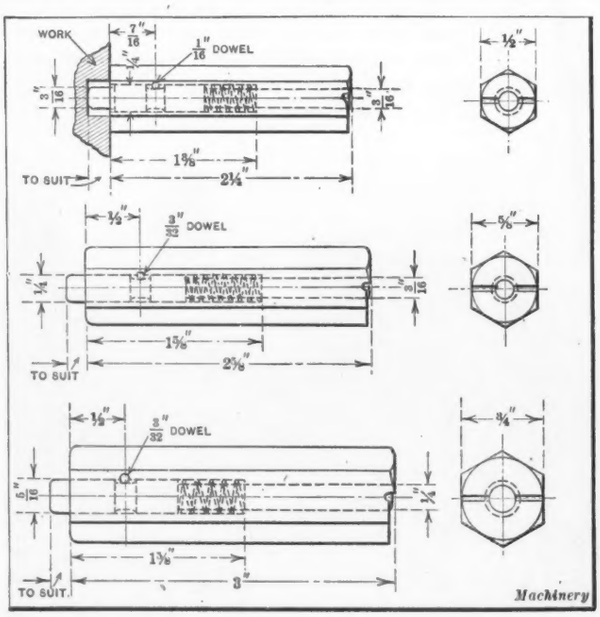


Fig. 1. Simple Type of Flush-pin Gages

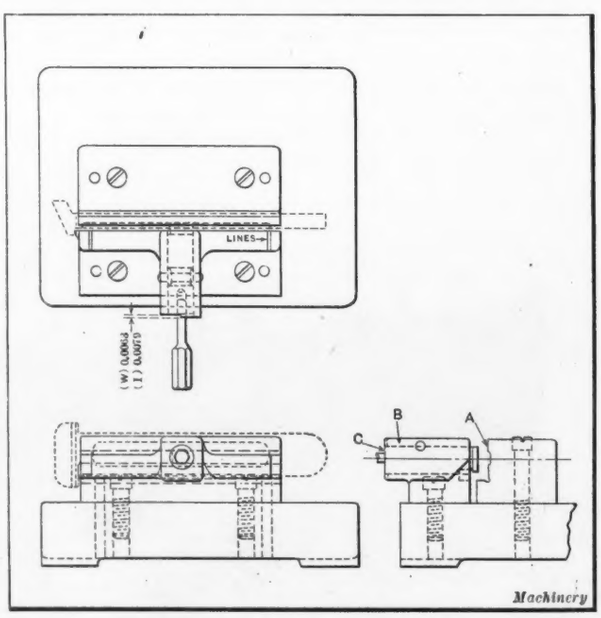


Fig. 2. Gage employing the Flush-pin Principle

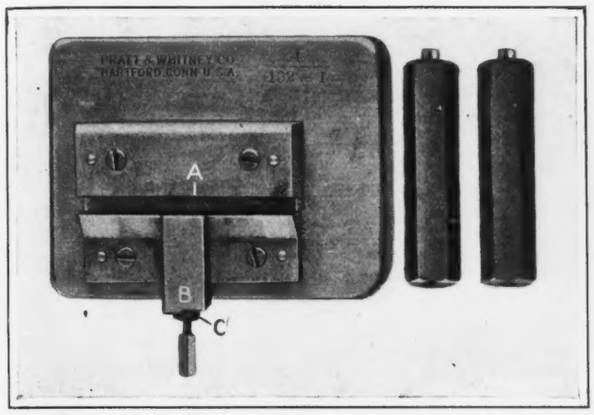


Fig. 3. (Right) Flush-pin Gages of the Type shown in Fig. 1; (Left) Flush-pin Gage of the Type shown in Fig. 2

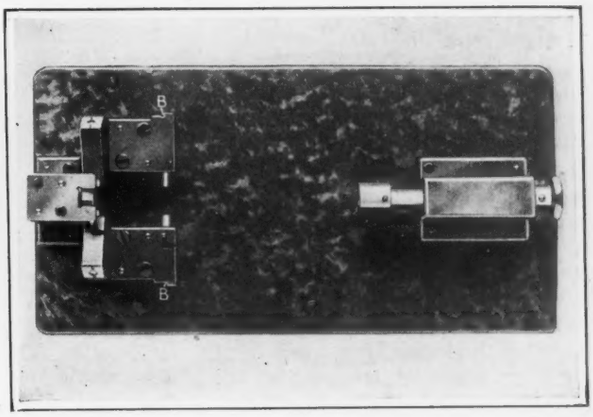


Fig. 4. Flush-pin Gage having Four Flush Pins or Plungers, with Provision for holding and locating Work

hardened and ground, but neither the pin nor the hole is lapped. A movement of 1/32 inch is allowed for the flush pin by the dowel-pin above and below the gaging surface. The hexagon handle is made from cold-rolled steel, carburized, reheated, hardened, and ground on both ends, one end being entirely flush and the other with steps, as mentioned. The spring is made from 0.020-inch music wire. This simple construction of a flush-pin gage is possible, of course, only in cases where the work permits the direct application of the gage to the work. In more complicated cases, holding means are required for the work as well as for the gage. The principle of the flush-pin gage, however, is used in a great many instances, and various applications will be illustrated and described in the following.

Figs. 2 and 3 show applications of the flush-pin principle

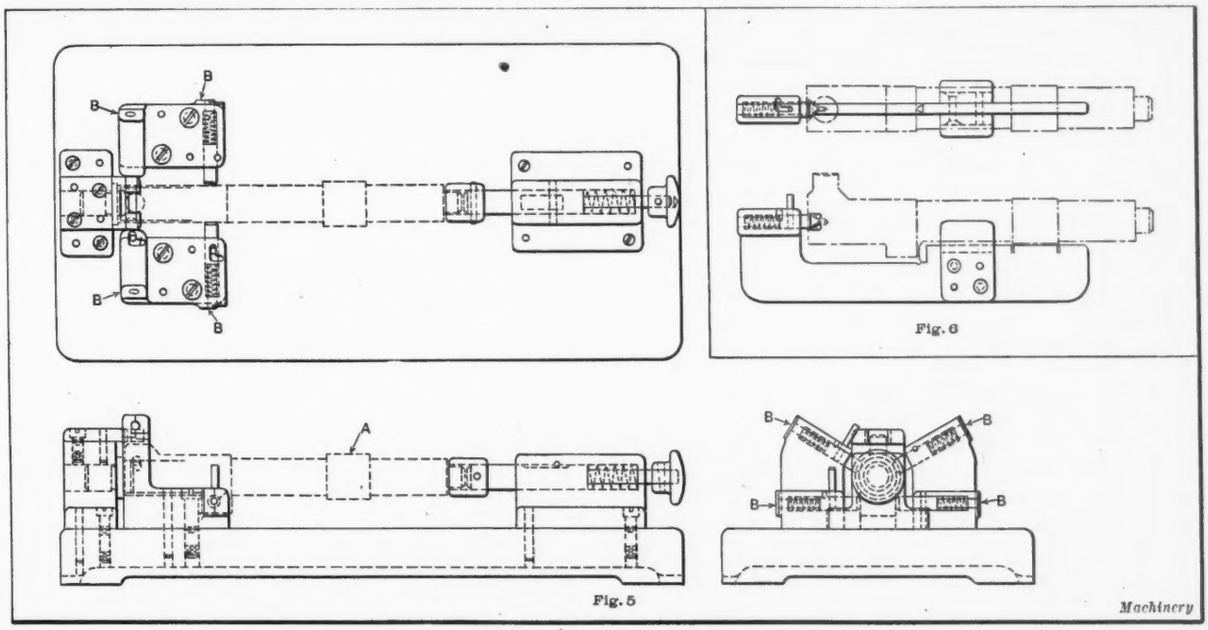


Fig. 5. Design of Flush-pin Gage shown in Fig. 4.

Fig. 6. Design of Gage shown in Lower Part of Fig. 7

in which the gage is used for measuring a recess to make sure that the wall at the bottom of the recess is of the right thickness. The simple type of flush-pin gage shown in Fig. 1 and to the right in Fig. 3 could not be used in this case, as such a gage would simply measure the depth of the recess.

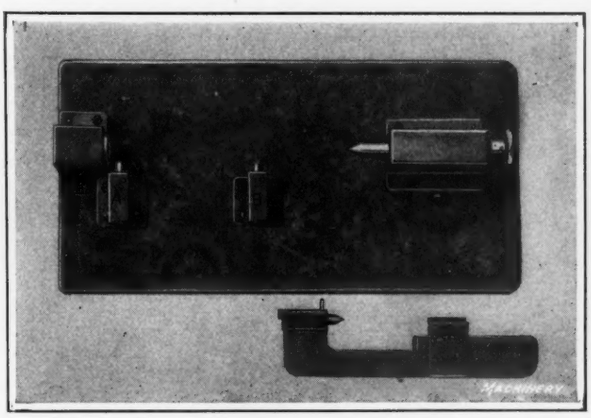


Fig. 7. Flush-pin Gages for gaging a Piece for Depth and Concentricity of Centers

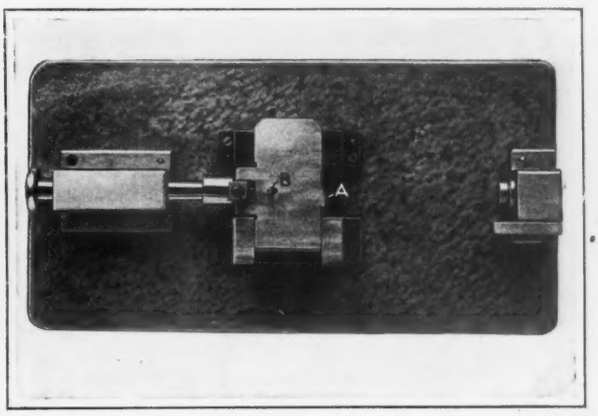


Fig. 8. Flush-pin Gage provided with Swinging Leaf for Convenience in inserting and removing Work

The object to be gaged is placed with its side against the edge *A*, while the flush pin enters the slot at the opposite side. In this way, the actual thickness of the wall at the bottom of the slot is measured. A reference piece having the same thickness as is required in the wall is used for checking the gage. The flush pin is provided with a handle. Steps are ground on the end of part *B* of the gage, and a shoulder is provided at *C* for determining whether the work is between the required limits. Figs. 4 and 5 show a flush-pin gage having four flush pins or plungers. It will be noted that the front plungers may be pulled back and held in the rear position by a groove milled somewhat similar to a bayonet lock. Means are provided for holding the piece of work that is to be gaged in the proper position, the work being indicated by the dotted lines at *A*, in Fig. 5. Steps are ground at *B* to correspond with the limits on the work.

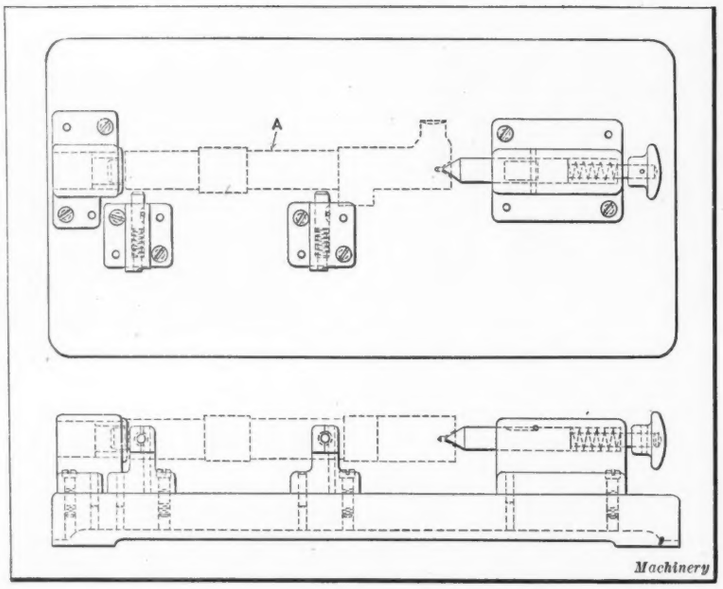


Fig. 9. Design of Gage shown in Upper Part of Fig. 7

The gages shown in Fig. 7 are used for gaging a piece immediately after it has been centered. The gage shown at the bottom is first used for determining the depth of the center, and then the piece is placed in the fixture at the top, where the two flush pins at *A* and *B* determine whether it runs out or not. This type of gage is simpler than a dial gage, and when a standard gage-plate is used, to which are attached the small parts on top of it, it is cheap to make. Standard gage-plates similar to those described in the installment of this series in the December number of MACHINERY, are employed whenever possible as the base for gages or gaging fixtures of this kind. The gage shown in Figs. 4 and 5 is also built up on a standard gage-plate. The construction of the lower gage in Fig. 7 is also shown in Fig. 6, where the appearance of the piece being gaged and the position of the locating surfaces are also indicated. The gaging fixture shown in the upper part of Fig. 7 is illustrated in Fig. 9, where the dotted lines at *A* show the part being gaged and clearly indicate the method in which the gage is applied.

Fig. 8 shows a swinging-leaf flush-pin gage, the swinging leaf being used because it is necessary to remove the flush pin from the gaging position when the piece being gaged is put in position or removed; hence, by mounting the flush pin in a leaf, it can be swung out of the way for insertion and removal of the work, and then swung into place for gaging. The gaging surface is at *A*, and the small pin at *B* holds the gage in position, but permits it to move the required amount for gaging. Fig. 10 shows a different design of swinging-leaf flush-pin gage embodying the same principle. Here four flush pins are employed. Those at *A* and *B* are bent at the ends and measure the location of the ends of a slot milled in a rifle part. After having gaged the location of the ends of the slot, the leaves *A* and *B* are swung out of the way and leaf *C* is swung into position. This leaf has two flush pins *D* and *E* which measure the depth of the slot and its position sidewise. At *F* are provided locating means for holding the part being gaged in the correct position.

Fig. 12 shows a flush-pin gage that has one vertical and one horizontal flush pin, indicating the different constructions possible and the great variety of gaging fixtures based in practice upon the flush-pin principle. In Fig. 13 is shown a flush-pin fixture in which the flush pin is mounted ver-

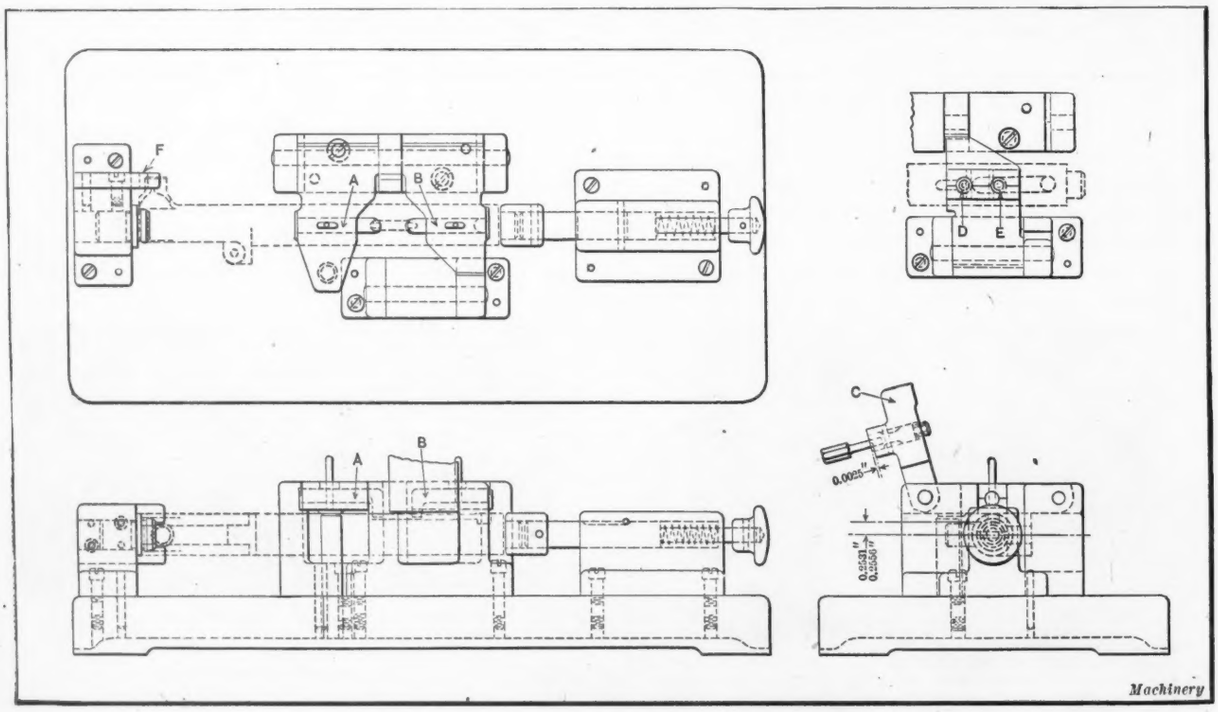


Fig. 10. Another Design of Swinging-leaf Flush-pin Gage

tically and is moved by the pin *A*. This same fixture is shown in Fig. 11 where the bayonet lock for the pin is shown, making it possible to hold it in its upper position while the work is put in place. At the side of the fixture, a pin *B* is shown which operates the ejector by means of which the piece is easily removed after gaging. The knurled-head pin *C*, shown in Fig. 13, is merely used for holding the work in position. In Fig. 11, the construction shown is slightly different, but the object of the pin in the hole at *C* is the same. The plunger of the flush pin itself has its end shaped so as to fit the contour of the work to be gaged.

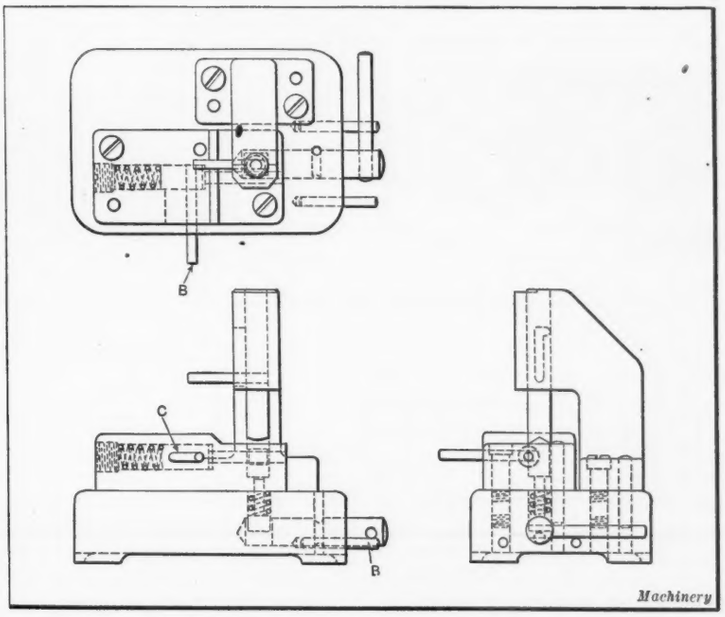


Fig. 11. Flush-pin Gaging Fixture of the Same Type as that shown in Fig. 13

Figs. 15 and 16 show an interesting gage used for testing the direction of a deep hole drilled in a piece of work. This gage or fixture is used for determining, while drilling, if the hole runs true or if it runs out and how much. Of the two fixtures shown in Fig. 16, one is the working gage while the other is the inspection gage. The auxiliary arbors are shown below the fixtures themselves: *A* is the working arbor; *B*, the inspection arbor; *C*, the inspection gage for the size of the hole; *D*, the working gage for the size of the hole; *E*, the reference piece for checking the gage; and *F*, a reference snap gage for inspection gage *C*.

The method of using the gage is as follows: The arbor *A* or *B*, according to whether the working or inspection gage is used, is first inserted into the work to be gaged. This arbor has, at the end, an expanding part at *a*, which enters into the hole, and a conical part at *b*, which engages the outer end of the hole. On the outer projecting end of the arbor, there are two cylindrical portions *c* and *d* which, when the piece to be gaged is placed in the V-blocks of the fixture with the arbor in place, extend out in front of the flush-pin gages at *G* and *H*. In this way, it is possible to determine whether the hole in the piece being gaged is straight within the prescribed limits, as otherwise the projecting ends *c* and *d* will be out of alignment and force the flush-pin gages beyond the limits prescribed for them. The expanding part *a* is held in contact with the sides of the hole into which it is inserted simply by the springing action of the arbor itself, the diameter over *a* being slightly larger than the diameter of the hole in the piece being gaged. Fig. 15 shows the construction of this gage in detail, indicating the action of the flush-pin gages which act in a vertical direction and which are held in the upper position by pins *K* and a bayonet lock.

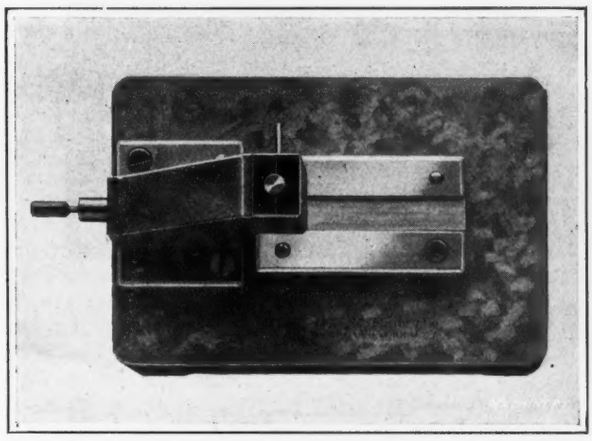


Fig. 12. Gage with One Vertical and One Horizontal Flush Pin

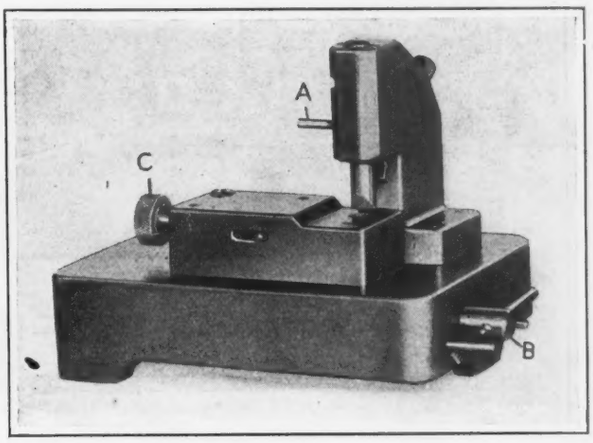


Fig. 13. Flush-pin Gaging Fixture with Vertical Flush Pin

Fig. 17 illustrates an interesting application of the flush-pin gage principle. The gage shown in this case is used for gaging the depth and central position of a slot in the piece shown in Fig. 14, and also indicated at *A* in Fig. 17; *B*, in Fig. 17, shows the reference gage used for the inspection gage. In application, the part shown in Fig. 14 is pushed onto the arbor of the gage and the flush pins enter at the ends of the slot *C*, and indicate thereby both the depth of the slot and its location in the piece being gaged. The plates screwed onto the gage at the right-hand end, as shown in Fig. 17, are the locating means which hold the piece in position while being gaged.

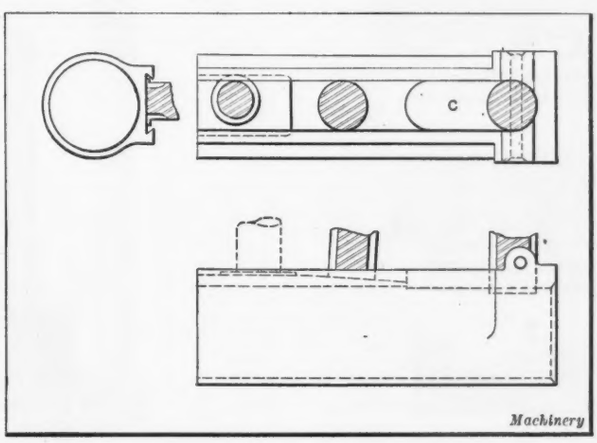


Fig. 14. Work gaged in Fixture shown in Fig. 17

Fig. 18 shows another application of the flush-pin gage principle, in which an adjust-

able feature is incorporated to take care of wear. The work here is placed over the upright *A* while the gage is swung around over the work, as shown to the right, for gaging. When the work is taken off the upright *A* or placed in position on it, the gage can be swung out of the way as shown to the left. As the top of the upright or the end of the head of the screw which comes in contact with the work when gaging will gradually wear, the screw can be adjusted to the proper position, and then clamped in place by the two check-nuts shown, one at the top and one at the bottom of arm *B*.

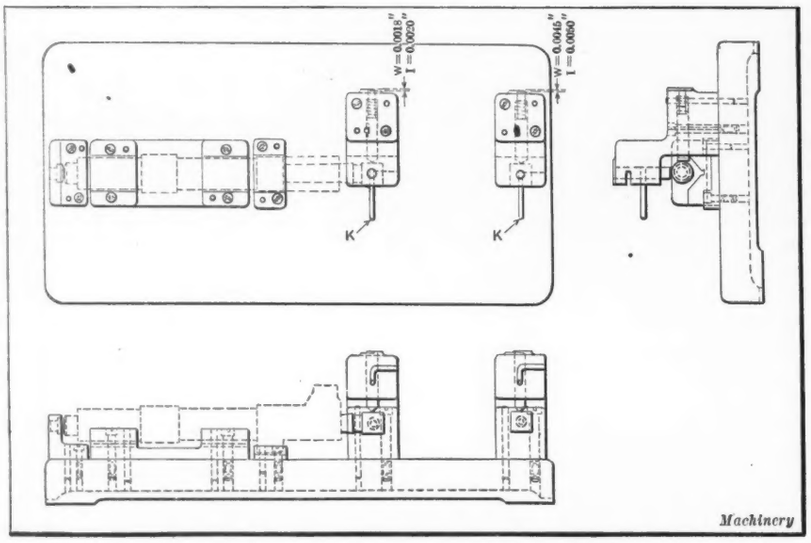


Fig. 15. Gage for testing Direction of a Deep Drilled Hole

The advantages of flush-pin gages may be briefly summarized as follows: The flush-pin gage is the simplest form of gage for measuring or gaging the position of one surface with reference to a locating point, when the relation is such that a snap gage cannot be used. Flush-pin gages are subject to a comparatively small amount of wear; if they do wear, the repairs necessary are cheap. They are reliable, and mistakes in reading the indications on them are not likely to happen. If the tolerance on the work is changed, the limits on the gage may easily be altered, merely by regrinding the steps. Except for the snap gage, and the plug gage, the flush-pin gage is probably more widely

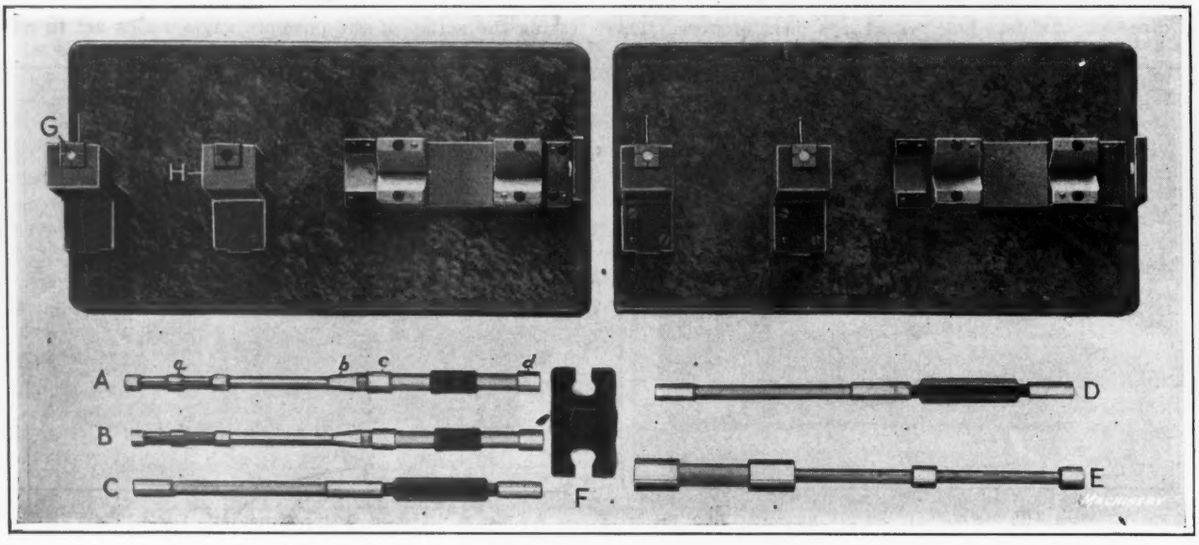


Fig. 16. Gage shown in Fig. 15, and Auxiliary Arbors used

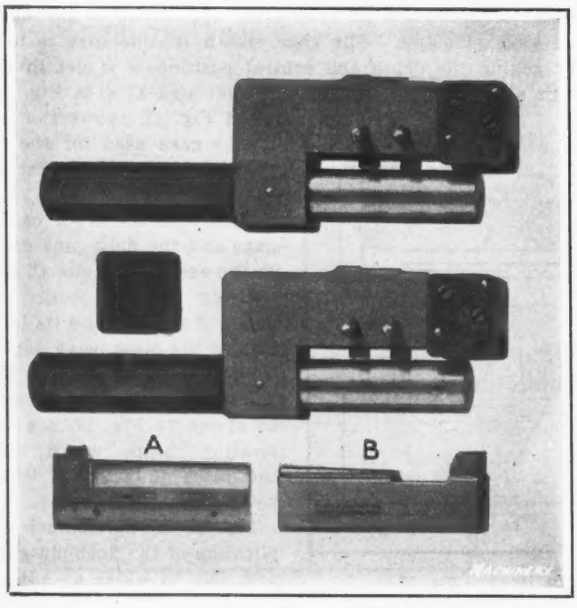


Fig. 17. Flush-pin Fixture for gaging Depth and Position of a Slot

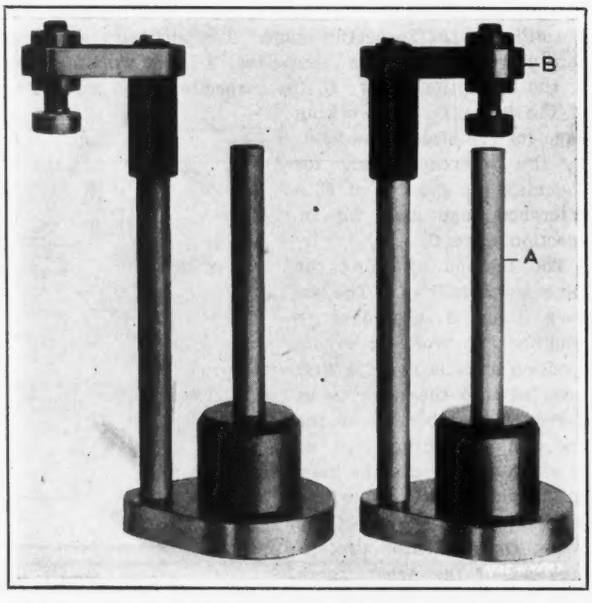


Fig. 18. Flush-pin Gage having Adjustable Feature to take Care of Wear

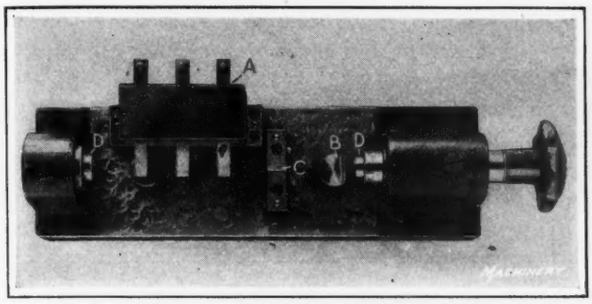


Fig. 19. Sliding Bar Gage with Three Sliding Bars

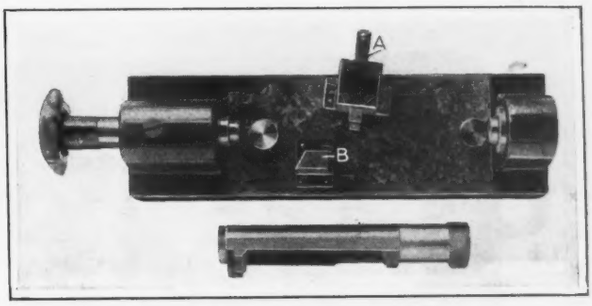


Fig. 20. Another Example of a Sliding Bar Gage

used than any other types of gages, especially for small arms work.

Sliding Bar Gages

Among the gages employing sliding members, the sliding bar gages occupy an important place. In principle, they are somewhat similar to flush-pin gages, but differ in regard to the method of taking the readings or indications. Fig. 19 shows a sliding bar gage provided with three gaging points. Two of these measure the length of a slot, as indicated in Fig. 21, while the middle one indicates the location of one side of the slot. All three bars are provided with "Go" and "Not Go" steps on their ends; hence, the sliding bar will slide into the slot to a certain point, but after the "Not Go" step has been reached, it must not slide in any further. Lines may or may not be provided at the outer end of the sliding bars at *A* to indicate when they have slid in to the proper depth. The plug *B* supports the work to be gaged. The small V-block at *C* locates the work, and the plugs *D* support and locate the work with regard to its axis.

Fig. 20 shows a sliding bar gage which gages the position or the distance of a slot from the end of a piece. The part being gaged is shown in Fig. 22, where the arrow indicates the surface that is being gaged. The face of this surface is at an angle with the end of the piece; hence, the sliding bar is at an angle with the fixture. Lines are marked on the sliding bar as indicated at *A* for the "Go" and "Not Go" positions. The sliding bar must pass in as far as the "Not Go" line, but must not pass beyond. The plugs shown in the baseplate of the fixture, the studs at the centers, and the part *B* are used for locating the work in its proper position in the fixture. This fixture is shown in detail in Fig. 23, where the work being gaged is shown in position by dotted lines.

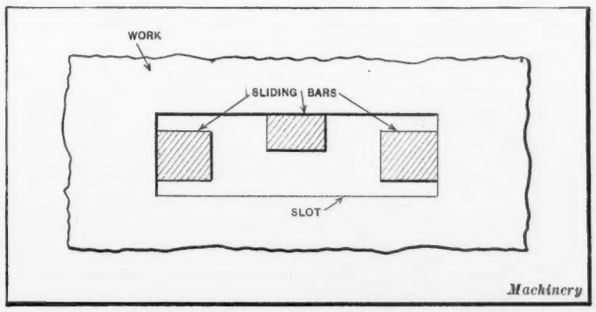


Fig. 21. Application of Sliding Bar Gage in Fig. 19

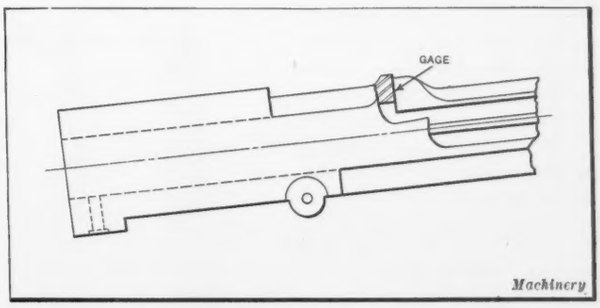


Fig. 22. Work for which Gage in Fig. 20 is used

Fig. 25 shows three examples of sliding bar gages, where the sliding bar is cylindrical and provided with lines as shown at *A*. Gages of this kind can be used to advantage when the tolerances are sufficiently large so that the eye can easily distinguish whether the line falls between the steps indicated on the end of the hub *B*. This gage is, strictly

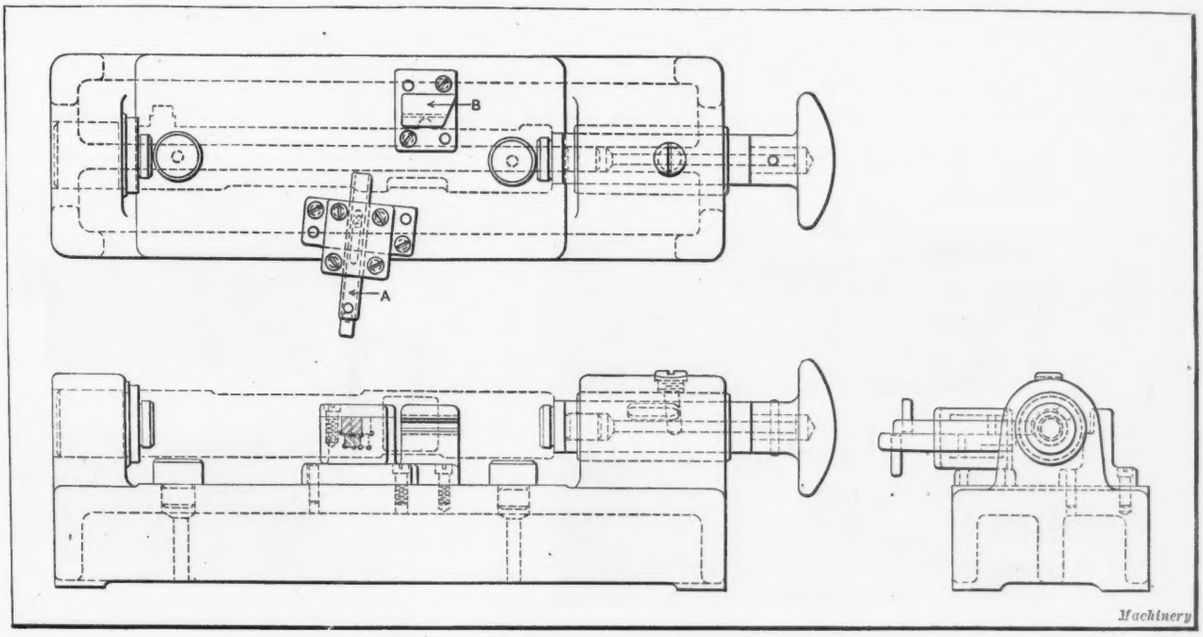


Fig. 23.. Design of Sliding Bar Gage shown in Fig. 20

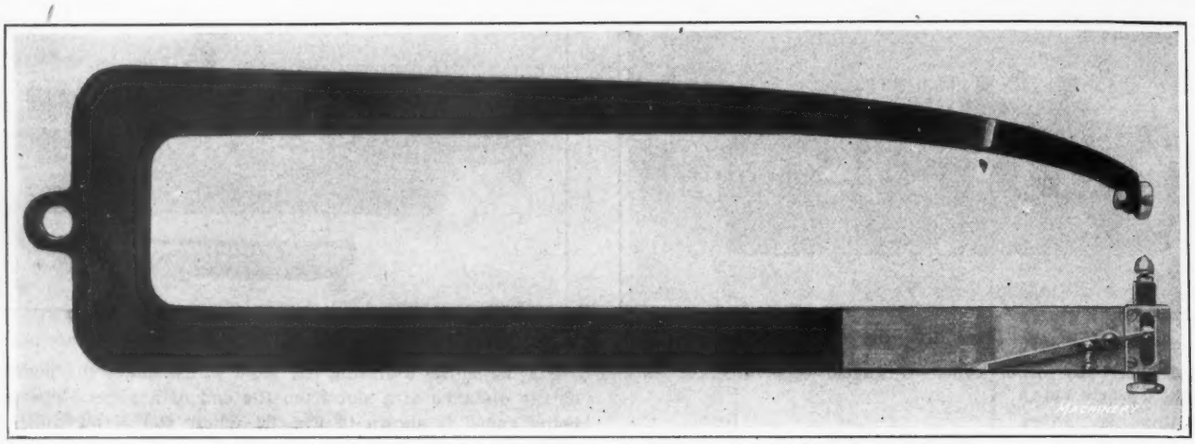


Fig. 24. Sliding Bar Gage with Multiplying-lever Attachment

speaking, a flush-pin gage having a line marked on a pin, instead of a flat end surface, as the gaging means. Fig. 24 shows another sliding bar gage in which the movement of the bar is multiplied by the application of a lever which reads along a graduated scale on the side of the gage. In this way, it is possible to note quickly whether the work is within the prescribed limits, even though the movement of the sliding bar is comparatively small. This principle may be applied to sliding bar gages where the tolerance is too small to be read off directly by lines scribed on the moving plunger itself.

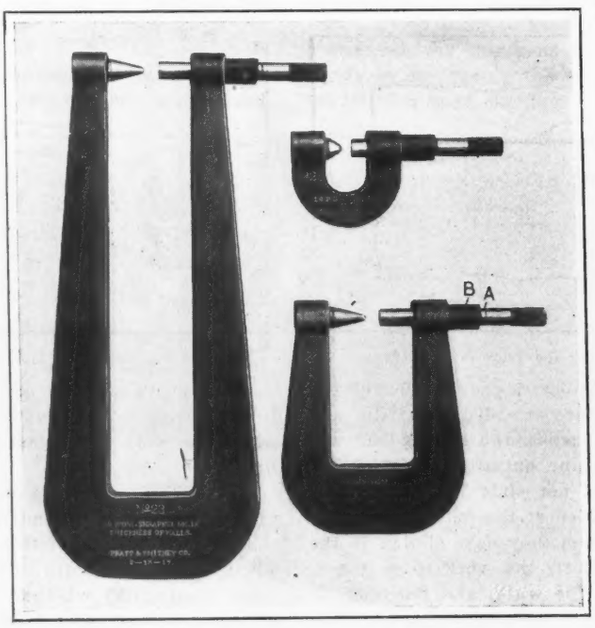


Fig. 25. Sliding Bar Gages with Cylindrical Bar

Hole Gages

By "hole gages" are meant such gages as gage the position or location of holes. Sometimes, and in fact frequently, they may gage the diameters of the holes at the same time as they gage positions. They may, for example, measure the distance between two holes, and at the same time the plungers or other means used for gaging may act as a check on the hole diameters. Hole gages do not, however, measure center distances directly. What they measure is the distance between the outer and inner points of the peripheries of the holes; but while the gage does not measure the center distance, it does insure that the parts may be assembled properly, provided the gage is designed in a satisfactory manner. Figs. 26 and 28 show a hole gage which is used for determining if the holes or circular ends of a spline-milled slot are correctly located. The piece of work is placed upon the plugs or studs at the ends of the fixture, and rests upon the studs driven into the bottom plate of the fixture, while the two movable gaging points *A* and *B*, Fig. 28, are pushed into the ends of the slot to determine that the holes at the ends are properly drilled.

Fig. 27 shows another simple type of hole gage with the piece to be gaged to the left. This piece is also of the same appearance as the reference gage, so that the illustration shows how the complete set of working, inspection, and reference gages would appear. The work has a large hole at *A* and a small hole passing through it at *B*. When tested in the gage, the large hole is passed over plug *C* while the two plungers *D* and *E* enter into hole *B*. The gage thus determines the location of the small hole with relation to the large hole, and also determines the location of the small hole with regard to the bottom of the

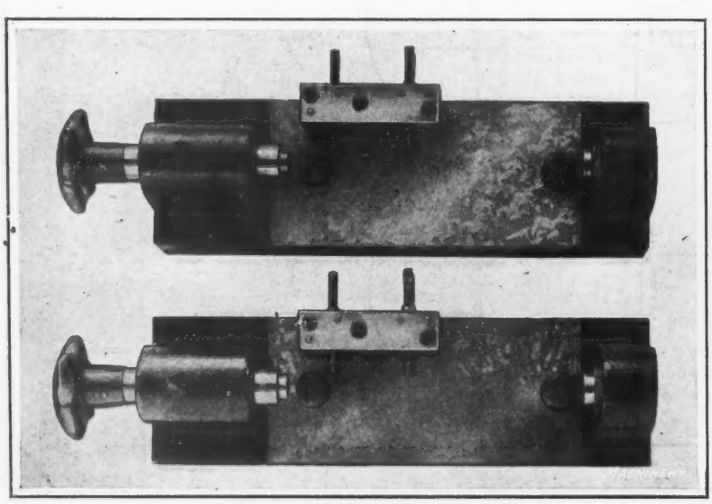


Fig. 26. Example of a Hole Gaging Fixture

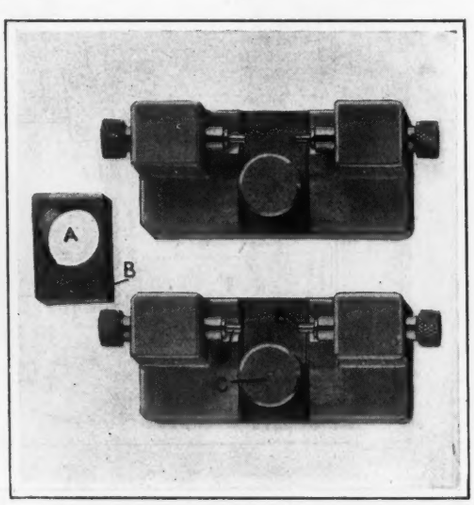


Fig. 27. Another Type of Hole Gage

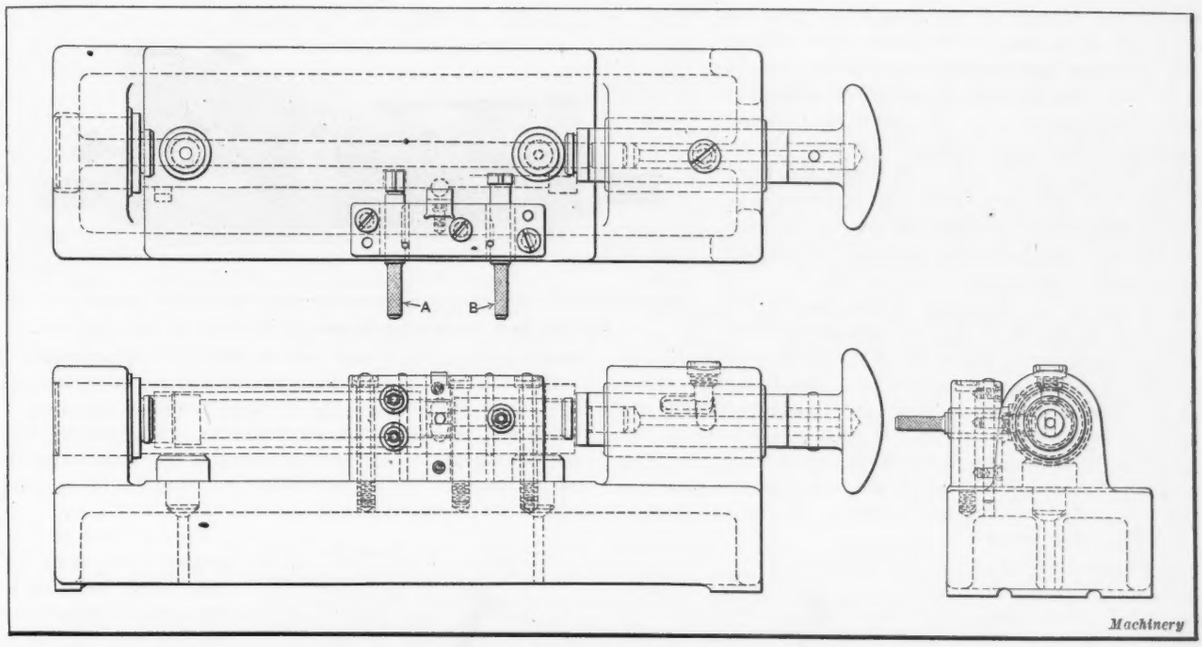


Fig. 28. Design of Hole Gaging Fixture shown in Fig. 26

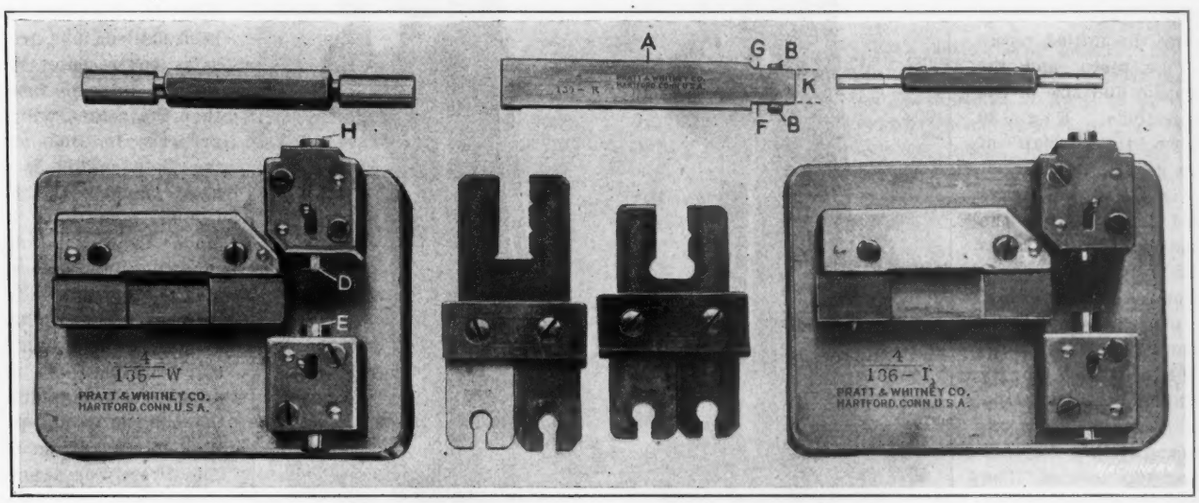


Fig. 29. Complete Set of Gages for Location and Accuracy of Projecting Bosses

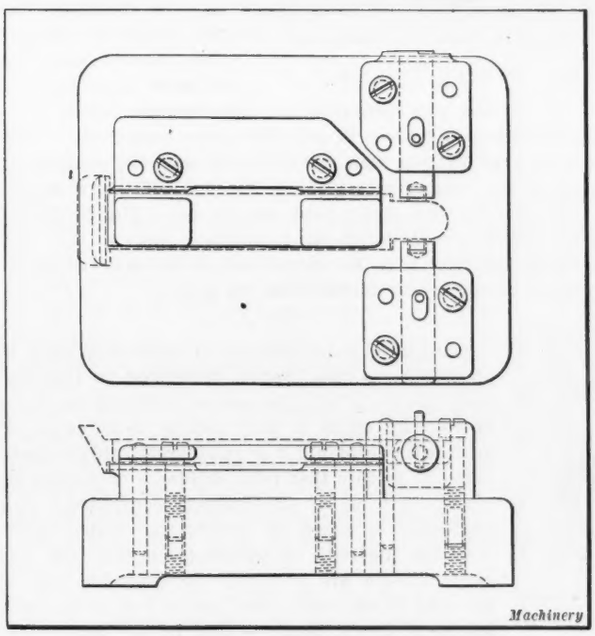


Fig. 30. Design of Gage shown in Fig. 29

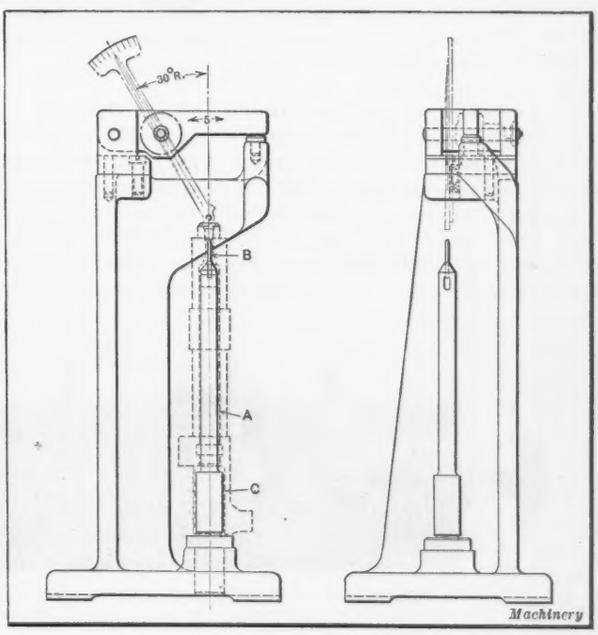


Fig. 31. An Indicating Hole Gage

piece, as the bottom of the piece rests upon the top surface of the base of the fixture while gaging.

Fig. 29 shows the complete set of gages used for gaging the location and accuracy of projecting bosses of a piece of work. The hole-gage principle is applied, except that instead of a hole, a projection is being gaged. At *A* is shown the reference gage or reference piece, the appearance of which is practically the same as that of the piece to be made. The projecting bosses, the location of which is to be gaged, are shown at *B*. The piece is placed in the gage, which has hollow plungers at *D* and *E*, so that the plungers will fit over the projections. The height of the projections, or rather the location of the milled surface at *F* and *G*, is also measured by these plungers, as there is a flush-pin gaging arrangement at the outer end *H*. The work is located in the gage in the same way as it would be located in a jig. The snap gages shown in the center are used for checking the diameters of the pins and the width of the milled surface at *K*. The plug gages shown are the reference gages for the inspection snap gages. The illustration, therefore, shows the complete set of gages used for measuring the milled recess in the piece, and the location and size of the projections. Fig. 30 shows the design of this gage in detail.

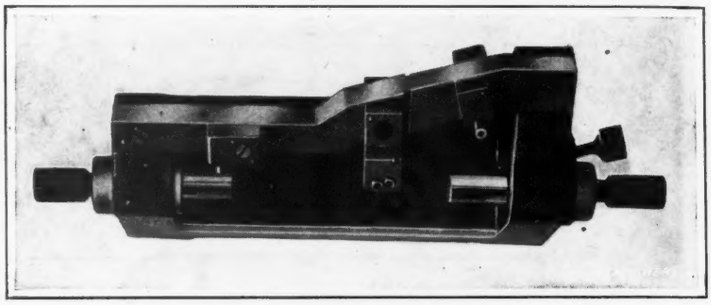


Fig. 33. Gage for checking Location of Six Holes at One Time

Fig. 32 shows a gage used for checking the location of three holes with reference to each other. A swinging leaf is used as a locating means for the work, while the three plungers, by entering the holes in the work, determine that they are accurately located. The plugs at the ends of the fixture are for holding the work while it is being gaged.

Fig. 34. Indicating Hole Gage, the Design of which is shown in Fig. 31

Fig. 33 shows a highly developed and complicated hole gage, which gages six holes at one time, five of which may be seen in the illustration. Six plug gages are used in connection with the gaging. The work is placed on the studs at the ends of the fixture and then the plugs are passed through the bushing holes in the fixture, and must enter the holes in the work. The diameters of the plugs used with this gage, as well as the diameters of the plungers used in hole gages generally, must be a suitable amount under the actual size of the hole being gaged to provide for the permissible tolerances, as otherwise the gage would require that the work be made to the absolute dimensions, which, of course, would be impracticable. Generally, the plugs or plungers are made 0.002 inch under the size of the hole, which allows for a tolerance of ± 0.001 inch on the center distance.

Figs. 31 and 34 show a special indicating hole gage used for indicating the accuracy of the recentering in a rifle bolt. After the hole in the bolt has been drilled, it is necessary to recenter the bolt in order to insure that the center will be properly in line with the hole. This is of great importance, as later operations are made from this new center and is the only means by which it can be insured that the outside of the bolt will be true with the hole. In finishing the outside of the bolt, it is not possible to work from the hole directly on account of its small diameter, and hence it is necessary to ascertain that the center is correct. The dotted lines in Fig. 31 show how the bolt is placed over the upright stud *A* of the gage, which it fits at the upper diameter *B* and the lower diameter *C*. The bolt is then rotated, and the indicator working against the side of the center, as shown in Fig. 31, will show on the scale whether the center runs out or not. The indicating gage levers are mounted on a swinging leaf so that this part of the gage may be swung out of the way when the work is placed in or removed from the gage.

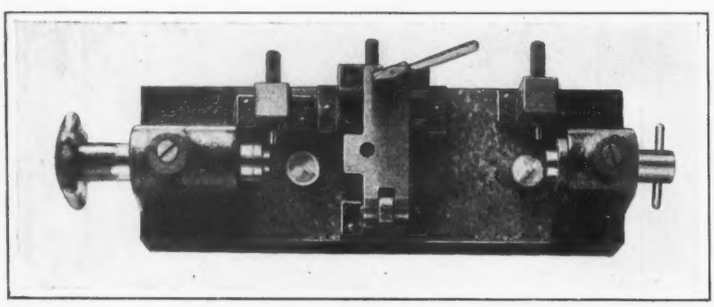


Fig. 32. Gage used for checking Location of Three Holes with Reference to the Locating Surface

* * *

The United States Bureau of Labor Statistics, in an article entitled "Safety Movement in Iron and Steel Industry," concludes that results of the study prove that while it may not be possible to do away with accidents it is quite practicable to make industry so safe that fatal accidents or serious accidents will be of exceptional occurrence. This conclusion is based on information which shows that the majority of accidents in the iron and steel industry are of minor character, but that 65 per cent of the total time loss is due to the fatal accidents which comprise only 1.5 per cent of the total number of accidents.

THE FOREIGN TRADE AFTER THE WAR

AN INTERVIEW WITH FRANK A. SCOTT, VICE-PRESIDENT OF THE WARNER & SWASEY CO.

"WHAT are your views of the after-the-war foreign trade prospects for the American machine tool builders?" Mr. Scott was asked.

"In the first place," replied Mr. Scott, "I sincerely wish we might substitute 'manufacturer' for the word 'builder' in referring to the American machine tool industry. While I know we use the word 'builder' even in the title of our great national organization, yet we must recognize that the industry outgrew that description of it years ago. Machines are now produced in quantity on an interchangeable basis in practically every American shop.

"The machine tool industry passed the building stage long ago, and having entered upon the manufacturing stage, with the consequent greater production, a broader market is required than that obtainable within the borders of the United States. The market here is large, but it is not sufficient for the present highly developed facilities of the machine tool manufacturing industry, and if the manufacturers of machine tools are to retain their supremacy as the world's leaders in their trade, they must take steps to maintain their plants on a manufacturing basis and provide an outlet for the quantity production that results from the improved modern methods and the facilities now available.

"This, to my mind, involves a broader opportunity than the mere expansion of trade. The machine tool industry is distinctly an industry of service. Machine tools help mankind to attain its ends with less strain on the individual—machine tools represent and are synonymous with progress. It is in this spirit we must meet our foreign neighbors and possible customers.

Domestic Market Large but not Sufficient

"The domestic market for machine tools, while it will have its ups and downs, will always remain large; yet it will not be sufficient to keep the large machine tool manufacturing plants of the United States fully occupied. A greater foreign trade will have to be developed along lines considerably different from those followed before the war. At that time the foreign market was considered by most manufacturers simply as an outlet for their surplus production, while the home market was their primary field. Many a manufacturer permitted the foreign purchaser to wait for deliveries while he supplied his home customer. This practice must undergo a radical change, because no great foreign trade can be built up on this basis. One thing that American manufacturers must learn, beyond everything else, is, that if they are to be successful in foreign trade, they must not allow distance or dissimilarity of language to make any difference in the treatment of a customer. The buyer who is five thousand miles away must be given equal consideration with the customer in the same or in the next city."

How Can the Foreign Trade in Machine Tools be Increased?

"Why is it reasonable to expect that with the conclusion of the war there will be a possibility for an increased trade in machine tools in foreign countries?"

"The answer is simple. War is a great educator and the European countries that have been engaged in the war, as well as those that have remained neutral, have felt the need for manufacturing facilities and quantity production as never before, and to a degree which twenty years of peace would not have produced. Now that the war is over, the peoples of Europe will turn their manufacturing facilities to the making of things that provide necessities and comforts in peace, rather than to those that are intended for destruction in war.

"In countries such as Russia and the Balkan States there will be a constant increase in the demand for the manufacture of the devices and facilities that provide these necessities and comforts. This, in turn, will greatly develop these nations industrially, and will require an increased supply of machine tools—a demand which these nations themselves will meet to a slight extent, but which, if intelligently recognized and met by American manufacturers, will largely be supplied by the American tool industry.

"There are two ways in which this foreign market may be cultivated and stimulated. One is to educate the foreign buyer to adopt American standards and to use American methods, by sending competent engineers as salesmen, who can thoroughly explain and demonstrate the uses and the advantages of American machines, and by the distribution of foreign language catalogues, containing proper technical descriptions of the machines intended for the foreign market, calling attention to the special advantages of the designs offered. The other method is to adapt the machines to the demands of the foreign market by trying to meet the individual needs and views of the customer, as the English and Germans did previous to the war. Either method will produce an increased volume of trade.

"It is highly important, however, that the men who are to sell American machine tools abroad should have a thorough and practical knowledge of the capacities and possibilities of the machine tools which they handle. Much of the work will be educational, and the representative must be more of an engineer than a salesman if he is to be successful in increasing American trade. This is of great importance in such countries as Russia, Spain, and South America, where future markets may be great, but where at the present time mechanical knowledge in certain metal-working lines is limited."

Methods of Representation

"What method of representation would in your judgment be desirable for the American manufacturer?" was the next question.

"The details of the methods to be used in acquiring foreign trade may be left to the intelligent judgment of each machine tool manufacturer. Some have reasons to prefer representation by local native agents; others, especially the larger firms, will have a direct representative of their own, but only a few manufacturers have a business large enough to warrant the adoption of this method. Others, again, will be represented by large American machine tool selling firms who have foreign agencies all over the world, a number of these selling concerns having developed a large business during the war. Finally, a number of non-competing manufacturers of machine tools—that is, makers of different lines of machinery might cooperate by establishing their own American agency abroad to handle their respective lines. Any method properly directed will produce good results. It is not the method employed as much as the interest and energy shown in working out the method, that will count most. No matter how good a selling organization may be developed, the confidence of the foreign customer must be gained and retained by square dealing, and by proving to him that he is given the same service as the domestic buyer. This, perhaps, is the most important consideration in the whole subject of foreign trade.

Conclusion

"The subject may briefly be summarized as follows: Whether or not there is a large foreign demand with the end of the war, there is no doubt but that a large foreign trade may be developed, providing American manufacturers of machine tools have a definite purpose and an unwavering determination to enter foreign markets and to succeed there. If the American manufacturer will work as carefully and

as assiduously in the development of a foreign trade as he has in building up and developing a great American trade, he can do it. The foreign trade is there for whoever will cater to it, and it can be stimulated and developed to a degree that few at the present time would venture to predict. With different political and economic conditions in Europe after the war, the rise of the European nations in industries and manufacturing will be rapid, and the American machine tool manufacturer has an opportunity to supply a large part of the trade stimulated by this development. All that he needs is to make up his mind once and for all that he is going to participate in this trade, and that he will render to his foreign customers the same fine service he has always given to the domestic buyer."

* * *

AN EFFICIENT WAGE CLASSIFICATION SYSTEM

BY A. SPANGENBERG

Superintendent, Ordnance Department, Mead-Morrison Mfg. Co., East Boston, Mass.

One of the most difficult problems to be solved by the superintendent or employment manager during these strenuous times, when skilled labor is so scarce, is the proper classification of prospective employes, with respect to the hourly rate of wages to be paid at the beginning of employment. It is, of course, the natural tendency of the machinist seeking new employment to demand the maximum hourly rate which he thinks can be obtained. In many instances, where factories have no well defined system of classification, men are often paid rates which are neither just nor fair to the employer nor to the employes, with the result that the employe is either discharged or he works along with a discontented feeling that he has not received a square deal.

While it is impossible to devise any system of wage classification that would fit all cases alike, the system described in this article has aided the solution of many difficult wage problems at the plant of the Mead-Morrison Mfg. Co., East Boston, Mass., where the system has been in use for some time with very satisfactory results. In fact, the system described possesses some fundamental principles which can be applied to almost any class of employment.

TABLE OF RATING VALUES

Length of Experience	Nature of Experience and Rating Values	Values of Practical Knowledge	
No. of Years	General	Machinist, Machine Operator, Toolmaker	
1	2	Engine Lathe	7
2	4	Vert. Boring Mill	6
3	6	Horiz. Boring Mill	6
4	8	Planer	5
5	10	Milling Machine	5
6	12	Turret Lathe	4
7	15	Slotter	3
8	20	Shaper	2
10	25	Radial Drill	2
12	30	Grinder	2
14	35	Screw Machine	2
16	40	Erecting Work	4
20	45	Bench Work	2
24	50	Spec. Qual.	
30	40	Remarks	
35	30		
40	20		
50	10		

Below 40 = third grade; between 40 and 80 = second grade; over 80 = first grade.

Minimum Wage Table

	Third Class	Second Class	First Class
Toolmakers	68	75	80
Machinists	62	68	75
Specialists	50	55	60

Machinery

Workman: G. Anderson — Shop Number: 1324

Department: Lathe — Grading: 2nd Class Machr.

Workman will write in column on right number of years experience he has had on the following Machines or Operations.

Engine Lathe	4
Vertical Boring Mill	
Horizontal " "	
Planer	3
Milling Machine	2
Turret Lathe	
Slotter	
Shaper	
Radial Drill	
Grinder	
Screw Machine	
Erecting	
Bench	
Gear Cutting	
Blacksmith	
Sheet Iron Worker	
Tool Maker	
Special Qualifications	
Total	

I hereby certify that the information as given above is correct

Signature G. Anderson.

Employment Classification Card

From a study of the Table of Rating Values, it will be seen that the system is based on the principle of classifying a man according to certain fixed rating values with reference to his number of years' experience at the trade and the practical knowledge acquired on each machine or class of work. The standard of comparison is 100 points or credit marks, as they may be termed. For illustration, if an applicant claims he has had three years' experience at the business he receives 6 points credit; if he says he can run an engine lathe 7 points are added; experience on a planer gives 5 more and on a radial drilling machine 2 more, making a total of 20 points. Referring now to the rating values at the bottom of the form, the man would be given a third class rating as a machinist with an hourly rating of 62 cents, taken from the minimum wage table. Again if a machinist had 24 years' experience, and claimed he could run an engine lathe, a vertical and horizontal boring mill, a planer, a milling machine, and a turret lathe, he would receive 83 points, which would give him a first-class rating with pay of 75 cents per hour. The rates in this table are assumed, of course, and are given merely for examples.

When hiring a man, he is given a card to fill out like that shown in the illustration, so that as a general proposition he is unaware of the system by which he is being classified, with the result that he is more likely to be honest in his claims. At the time of employment, however, the applicant is given to understand that it will be unwise to make false statements, as in all probability he will actually be tried on all the different kinds of machines or classes of work on which he claims experience and that his final classification will depend upon the actual merits of each case.

* * *

The Quebec Bridge over the St. Lawrence River, which collapsed twice during construction, passed its final test when two trains weighing 7000 tons were run on the central span.

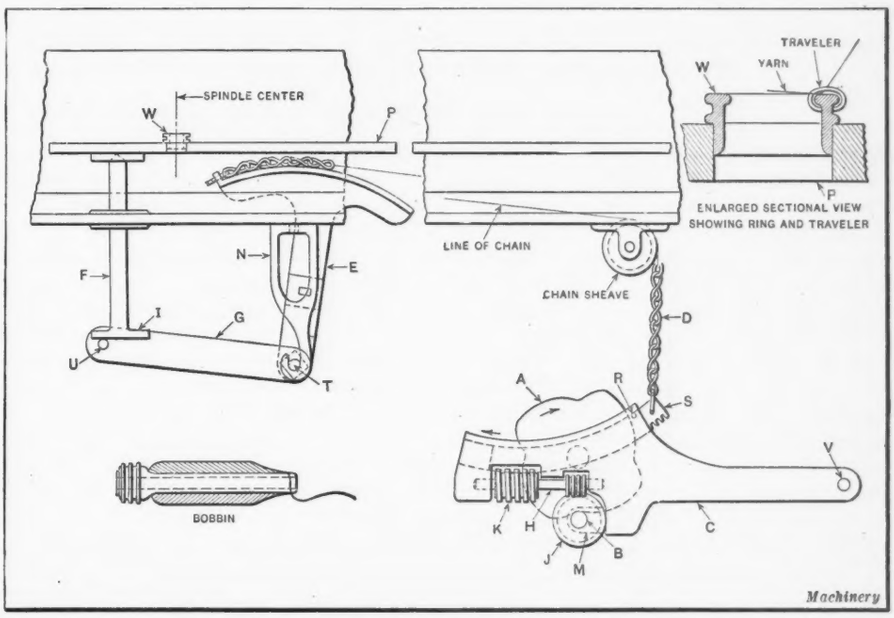
WINDING A FILLING YARN BOBBIN

There are two types of bobbins used on textile machinery, the warp bobbin from which the warp yarns are wound onto the warp beam, and the filling bobbin. The yarn is wound onto each type of bobbin in a different manner. The warp bobbin, or spool, is wound with a full-length traverse, that is, from end to end, since the yarn is unwound when the bobbins are in a position which is perpendicular to the unwinding thread. The filling bobbin, however, is unwound in the loom and from the end, as shown in the illustration, and it is therefore necessary to wind it in a different manner than is employed when winding the warp bobbin. The filling is wound on in short layers, and beginning at the bottom of the bobbin, each successive layer is started a little higher than the preceding one, so that the layers are "shingled" on, as shown. The length of the taper of the bobbin, that is, the length of the layers, is usually about 1¼ inch. A mechanism that will prove of interest to mechanics in general is used to obtain the required result. It will be noticed that cam *A* is designed to give a slow rise and quick return to the rails, the object of the quick return being to bind the layers firmly together. Binding the bobbin in this way prevents the yarn from slipping off in larger quantities than required as it is being unwound.

The building lever *C*, hung on shaft *V*, swings vertically as determined by the four-lobed cam *A*. This cam, which is mounted on an independent shaft, imparts movement to the building lever through its contact with the roll *B*. Roll *B* and worm-wheel *J* are mounted on the same shaft, or stud, the bearing for which is in the lug *M* on the lever. The building lever is supported and the roll is kept in contact with the cam by the tension which is exerted on the twisted-link chain *D*, by the weight of the rails *P* on the upright shaft *F*, augumented usually by weights which are hung on the cross-shaft *T*. It should be explained that each spinning frame or twisting machine has rail-lifting devices located along the rails on each side of the machine at regular intervals. By a rail-lifting device is meant the cross-shaft hanger *N*, the cross-shaft *T*, the lifting lever *G*, and the upright shaft *F*. There is, however, but one segment *E* required, since the several cross-shafts carry arms, which are connected by rods, and which operate in unison. Segment *E* is fastened to *T*, and is reciprocated by the two means just mentioned—the throw of the cam and the torsion exerted at *T*, caused by the weight of the rails. The roll *U* at the end of the lifting arm *G* is the support on which the shoe *I* of the upright shaft trundles.

The raising of the starting point for each successive traverse of yarn is accomplished by means of a curved sliding rack *S*, which operates in the lever *C*. It is driven by a single-lead worm *K* on shaft *H*. On the other end of this shaft is another single-lead worm, of very small linear pitch, which meshes with the worm-wheel *J*, previously referred to. Rack *S* is thus driven in the direction indicated by the arrow, and takes in the chain *D*. It is obvious that the result will be a higher starting point for every successive reciprocation of *E*.

When winding bobbins or spools for warp yarn, cam *A* is replaced with a heart cam of the necessary throw to produce the desired traverse. The throw usually required is from four to six inches. It is also necessary, of course, to remove rack *S* and to connect chain *D* direct to the lever, through hole *R*. Rails *P* run the entire length of the machine on each side, and carry highly polished steel rings with a flange at the top, as shown at *W*, set in at regular intervals, as for instance every four inches. The spindles which carry the bobbins revolve at a very high speed. The thread passes from a set of rolls to a clip or "traveler," as it is commercially known, and thence to the bobbin, (see enlarged view). The traveler rides on the flange of the rings, dragging on the thread, so that, as the rails rise and fall, the bobbin is evenly wound. F. R. D.



Device for winding Filling Bobbin used on Textile Machinery

* * *

AMERICANIZATION AS A MEANS OF REDUCING ACCIDENTS

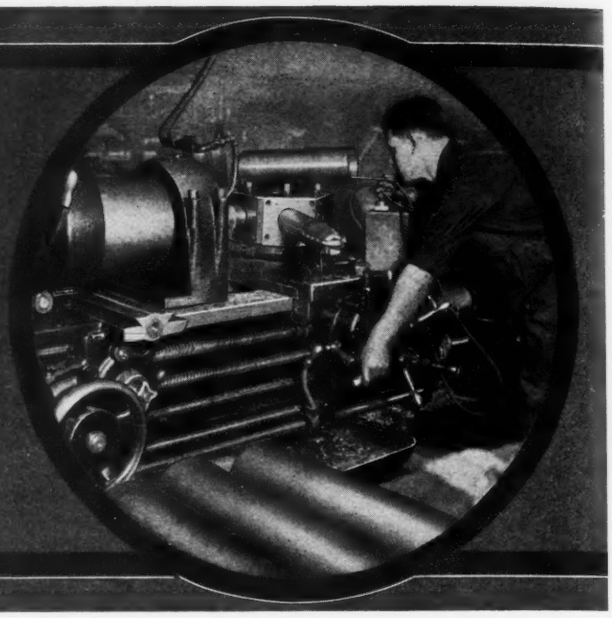
It appears that Americanization, as carried on in factories and shops, not only makes the employes better citizens and more efficient workers but also protects them against accident. The Department of Labor has recently published an analysis of the experience of a large steel plant during eight years, which may be taken as fairly typical of industry in general. For each 10,000 American-born workmen, 21 were killed during the eight years, and for each 10,000 non-English-speaking foreign-born, 26. The figures for permanently disabled, 28 and 65 respectively, show greater discrepancy, and those for the temporarily disabled, 858 and 2035, even more. Furthermore, while the frequency of accidents among English-speaking employes decreased from year to year, it was much less affected among non-English-speaking employes; and the average severity of the temporary disabilities was greater among the latter.

* * *

SUBSTITUTE FOR LEATHER BELTING

The *Practical Engineer* states that in view of the shortage of leather in Austria that country has produced a new industry which employs iron wire, and in some cases iron wire and paper twine combined, for producing belts for power transmission purposes. The standard type consists of double iron wire, spirally twisted together, and in part slightly copper-plated by a chemical process. These belts are made in sizes up to 4 inches wide. Another sample is of wire gauze strips interlaced with one-ply and two-ply paper yarn, partly with single and partly with double threads. It is bound at the edges with paper yarn, then impregnated with tar asphalt and flattened out between rollers.

Special Tools and Appliances for Shell Manufacture



First of Two Articles Describing a Number of Interesting and Ingenious Devices Used by the Buffalo Pitts Co., in Making 4.7-inch High-explosive Shells for the United States Army

By GEORGE A. NEUBAUER and ERIK OBERG

The manufacture of shells has been thoroughly treated during the past years in this journal, and the present article, therefore, will not take up all the details of the manufacture of the 4.7-inch shell as made by the Buffalo Pitts Co., but will deal specifically with the tools and devices that are peculiar to the company's methods and which have proved, in the experience of this manufacturer, to have been of especial value for increased production and a satisfactory quality of work. The mechanical ideas involved are applicable to many other lines of machine shop practice and tool design.

IN a previously published article in MACHINERY, the organization and system used by the Buffalo Pitts Co. in making 4.7-inch high-explosive shells was described. It will be recalled that this system was exceedingly simple and based upon the principle that no records should be made, except those that were directly useful either in facilitating the shop work or in aiding the executives to control the production. The same care and thought that has been given to the development of the system whereby the work is carried through the plant, has been given to the development of special tools and devices for the machining operations and other mechanical work in connection with the manufacture of the shells.

In the following will be given a complete list of the operations that the shells pass through from the time they are received in the plant until they are shipped. Details of the operations will be given, however, only in those cases where special tools or devices or some particularly interesting methods are used. Where simple machining operations only are employed, no special mention will be made. It may be stated, however, that a careful inspection is made after every actual machining operation so that there is always complete control of the work, and the shells are not passed to the succeeding machines unless they have been properly machined in the next previous operation. The operations are tabulated in the accompanying table, the reference letters there given corresponding with those given in Figs. 1 and 2.

Between Operations 11 and 12 in the table, Brinell and physical tests are made to determine that the heat-treatment and the quality of the steel are of the right kind. After Operation 20, it is sometimes necessary to swipe the inside of the shell to remove some metal in order to obtain the correct weight. As a rule, however, the correct weight is obtained by facing off the base.

Between Operations 25 and 26, a hydraulic test is made of 10 per cent of the shells. This test is similar in principle to the hydraulic test made on the 75-millimeter shells as described in the May, 1918, number of MACHINERY. Between Operations 28 and 29, a preliminary government inspection is made; between Operations 31 and 32, a government inspection of the copper band takes place, and the final government inspection is then made after Operation 35 and previous to the insertion of the wooden plugs and the varnishing of the outside of the shells. The accompanying illustrations Figs. 1 and 2 show the shell after the performance of each machining operation.

Special Tools and Operations

In Operation 2 (*A*, Fig. 1)—the rough-facing of the inside—the shell is held in a floating chuck, the bottom being faced by a floating reamer. The bottom is merely cleaned

OPERATIONS IN THE MANUFACTURE OF 4.7-INCH HIGH-EXPLOSIVE SHELLS

1. Receiving and tallying.
2. Rough-facing inside. (*A*)
3. Cutting off both ends and centering. (*B*)
4. Rough-turning outside. (*C*)
5. Rough-boring inside. (*D*)
6. Finish-boring inside and facing open end. (*E*)
7. Refacing base. (*F*)
8. Recentering. (*G*)
9. Nosing. (*H*)
10. Heating for hardening, and quenching.
11. Annealing.
12. Boring fuse hole. (*I*)
13. Re-turning. (*J*)
14. Finish-turning and profiling. (*K*)
15. Cutting recess back of thread. (*L*)
16. Grinding bourrelet. (*M*)
17. Cutting off base projection. (*N*)
18. Swiping inside. (*O*)
19. Weighing and marking.
20. Facing base. (*P*)
21. Cutting band and crimping groove. (*Q*)
22. Cutting base cover groove. (*R*)
23. Knurling. (*S*)
24. Milling stabbing groove. (*T*)
25. Reaming fuse hole. (*U*)
26. Milling thread. (*V*)
27. First washing.
28. Sand-blasting. (*W*)
29. Cleaning band groove.
30. Pressing copper band in place. (*X*)
31. Turning copper band. (*Y*)
32. Riveting base cover in place. (*Z*)
33. Second washing.
34. Varnishing inside.
35. Marking.
36. Inserting wooden plugs.
37. Varnishing outside.
38. Shipping.

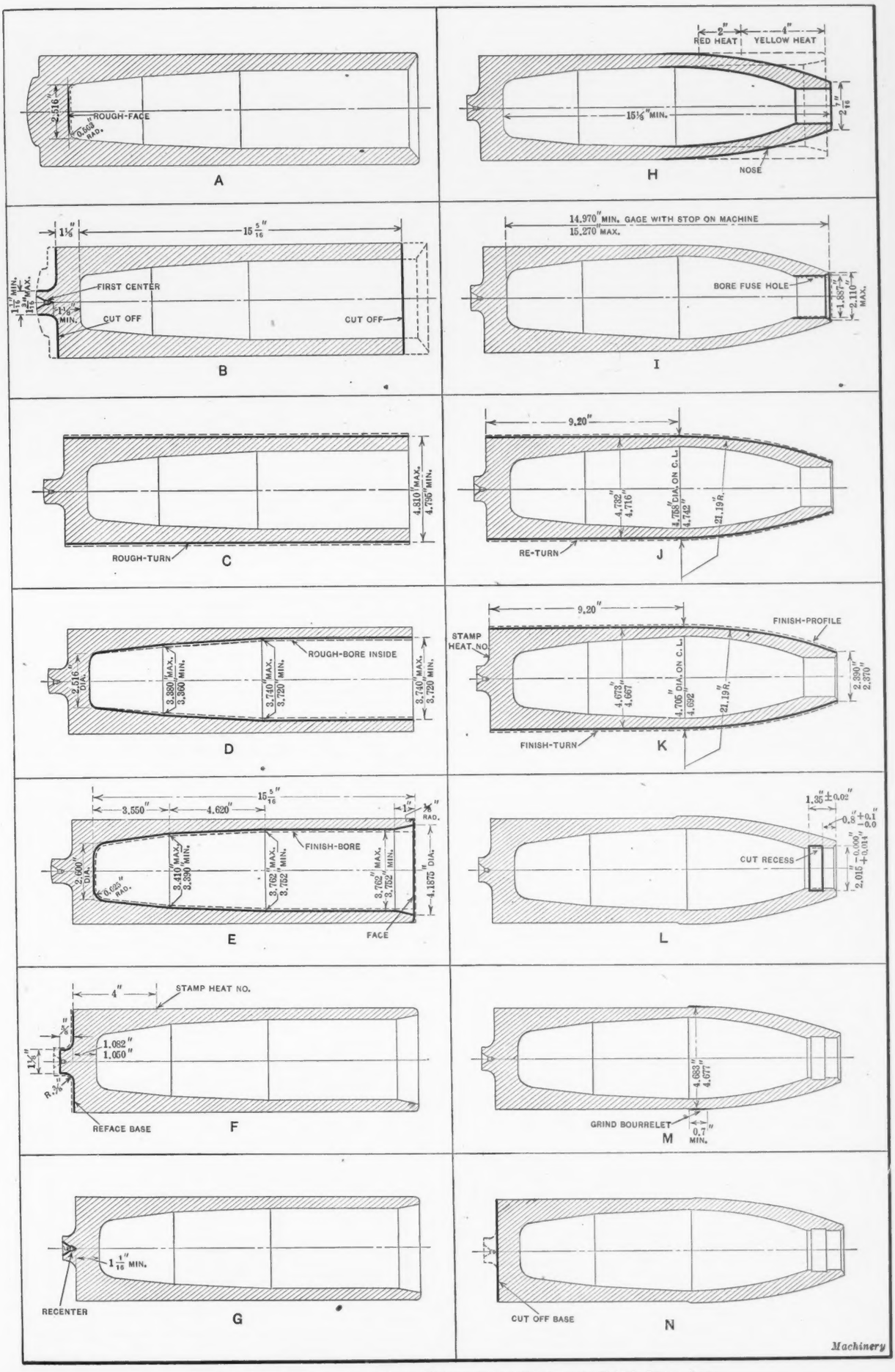


Fig. 1. Operations on the 4.7-inch High-explosive Shell for the United States Army

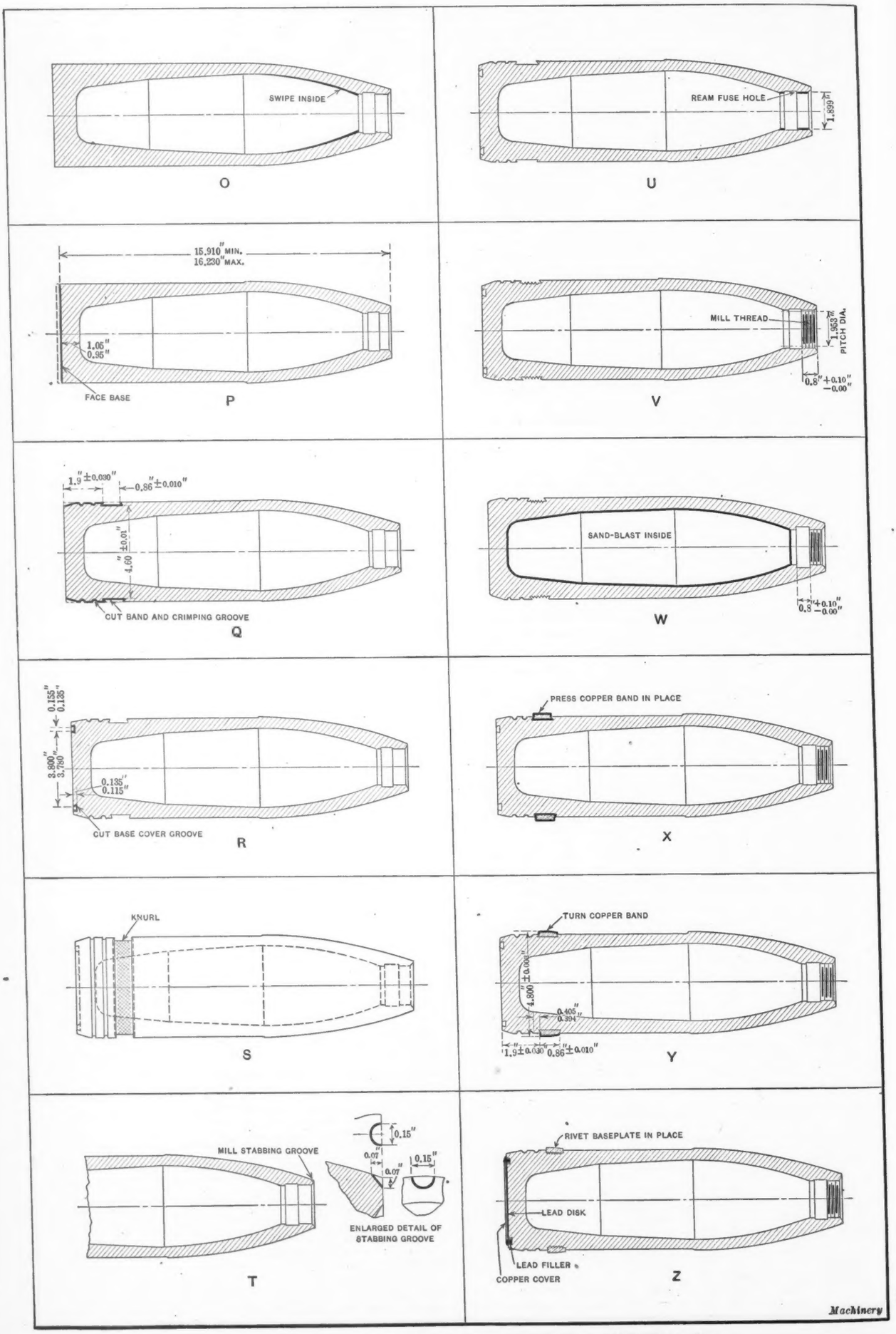


Fig. 2. Operations on the 4.7-inch High-explosive Shell for the United States Army

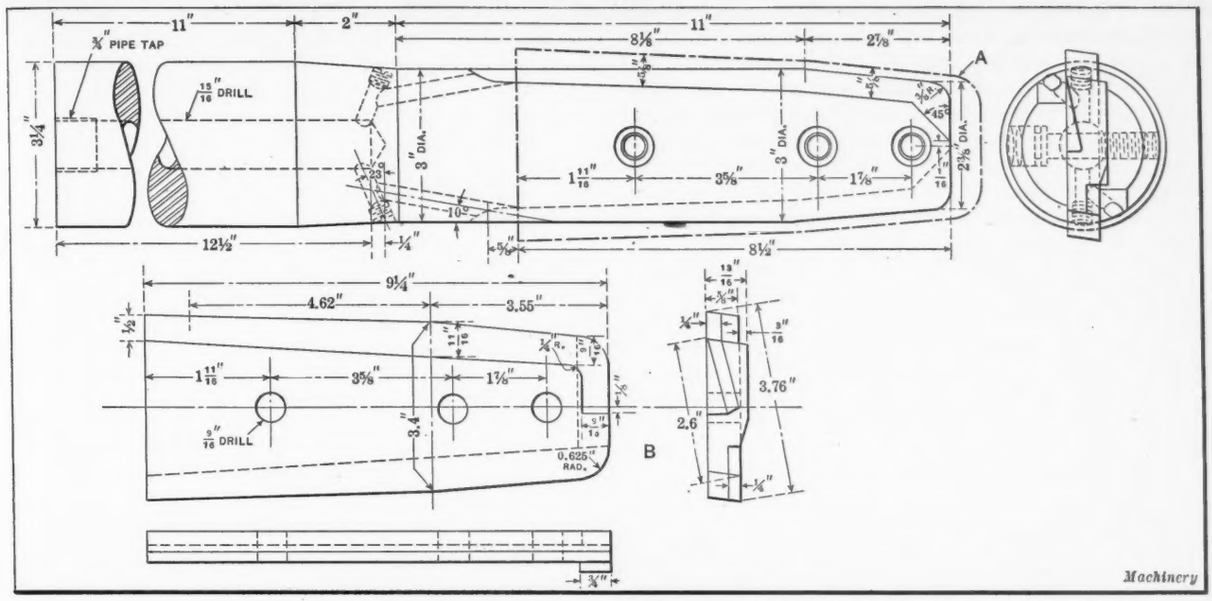


Fig. 3. Boring-bar or Reamer used for finish-boring the Inside of the Shell

out to provide a starting point from which subsequent operations may be gaged. Four machines are provided for handling the complete output of the shop for this operation, the idea being that this number of machines will be sufficient for turning out 1500 shells with a day and night shift. When the number of machines used is mentioned in the following operations, it is understood that the number given has a sufficient capacity for taking care of 1500 shells daily in two shifts.

Operation 3 (*B*, Fig. 1)—cutting off both ends and centering—is performed in a special machine developed by the Buffalo Pitts Co., from the ideas of the general superintendent, William Wolff. By cutting off the two ends and centering in the same machine at one chucking, there is a saving of two chuckings and of the time required for cutting off the open end, as the cutting off of this end is done simultaneously with the facing of the other end. During this operation, the shell is held entirely from the inside by an air-operated internal expansion chuck. Six machines are provided for this operation.

In Operation 4 (*C*, Fig. 1)—rough-turning the outside—the shell is held by a roller chuck on the inside and by the tail-center entering the center at the closed end. Nine machines are provided for this operation.

In Operation 5 (*D*, Fig. 1)—rough-boring the inside—the shell is held by an air-operated chuck on the outside. A single-ended tool guided by a profile bar is used. The reason for using a single-ended tool is to be sure that the inside will be bored true, as if a double-ended tool were used there would be a tendency to follow the hole already in the shell. One cut only is taken. Seven machines are required for this operation.

Operation 6 (*E*, Fig. 1)—finish-boring the inside—consists of taking two cuts with two different reamers—a roughing reamer and a finishing reamer. A turret lathe is used for this work. After the reaming operations, the turret

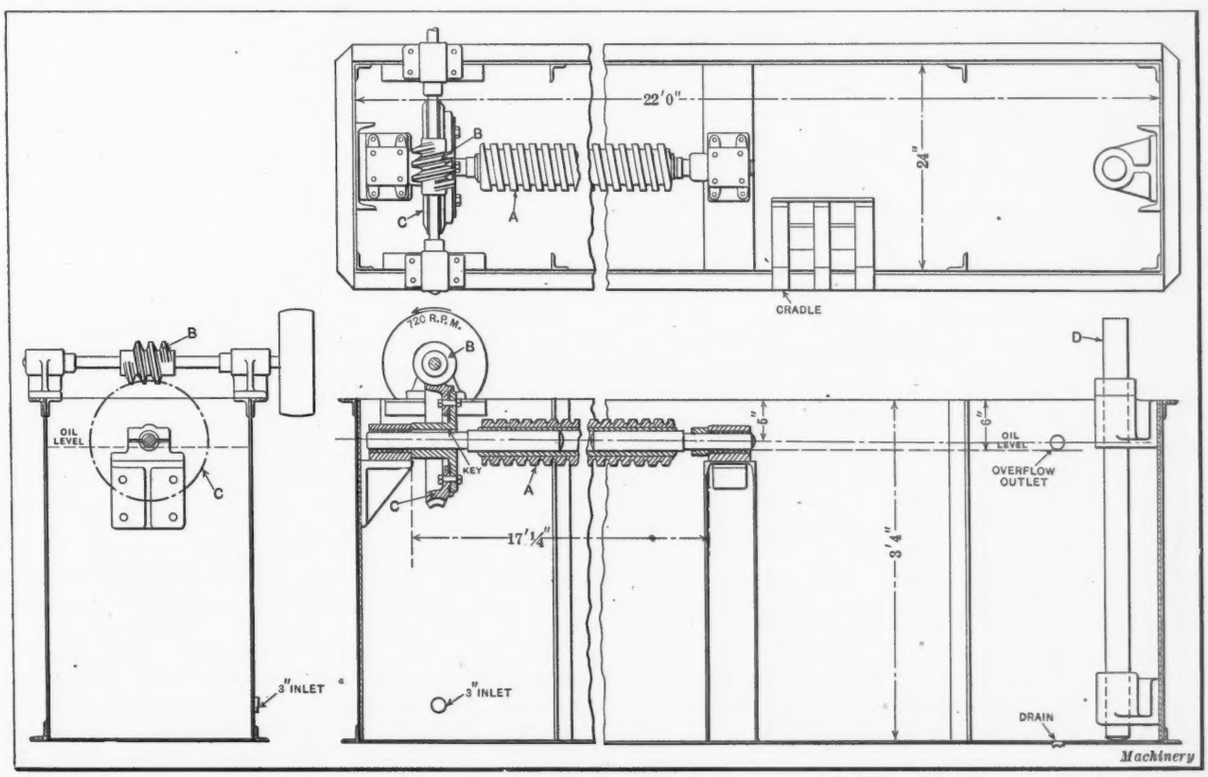


Fig. 4. Quenching Tank and Automatic Device for moving Shells through Oil

indexes to present a third face to the work, and the tools at the third indexing of the turret face the open end of the shell. Ten machines are required for this operation. The design of the boring-bar or the reamer used is shown in Fig. 3. It will be seen that it is provided with means for flooding the cutting edges of the reamer with oil. The body of the cutter *A* is made of a low-carbon tool steel, the cutting edge being lined with ¼- by ¾-inch high-speed steel, welded to the low-carbon steel body, the construction of the blade being as shown in the lower view at *B*.

The object of Operation 7 (*F*, Fig. 1)—refacing the base—is twofold. The solid end was originally cut off when the shell was in its rough state, and the face, therefore, is not certain to be square with the subsequent operations. In this operation, however, the shell is chucked from the outside, so that, when the base is faced, it is certain to be square with the outside of the shell. At this time, the original center, which is not true with the finish-bored inside of the shell, is cut off. Two machines are required for this operation.

In Operation 8 (*G*, Fig. 1)—recentering—the shell is held by a chuck on the inside. The object of this operation is to obtain a center that is true with the inside of the shell, so that all subsequent operations upon the shell will also be true with the inside. Two machines are required for this operation. Fig. 5 shows the expanding arbor that is used for holding the shell for the centering operation. The tapered end at *A* fits the inside of the shell near the bottom, while the split expanding bushing *B*, the end or jaws of which are forced outward by the taper *E* on the arbor holds the shell central at the outer end. The sloping bushing *C* is used merely for guiding the shell onto the expanding collet when it is put in place on the arbor. The

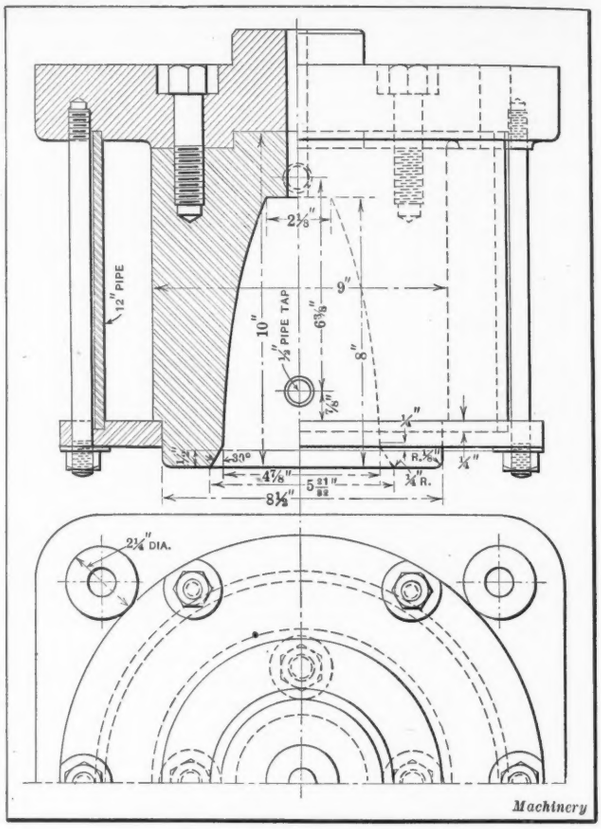


Fig. 7. Nosing Die used in Geared Crank Press

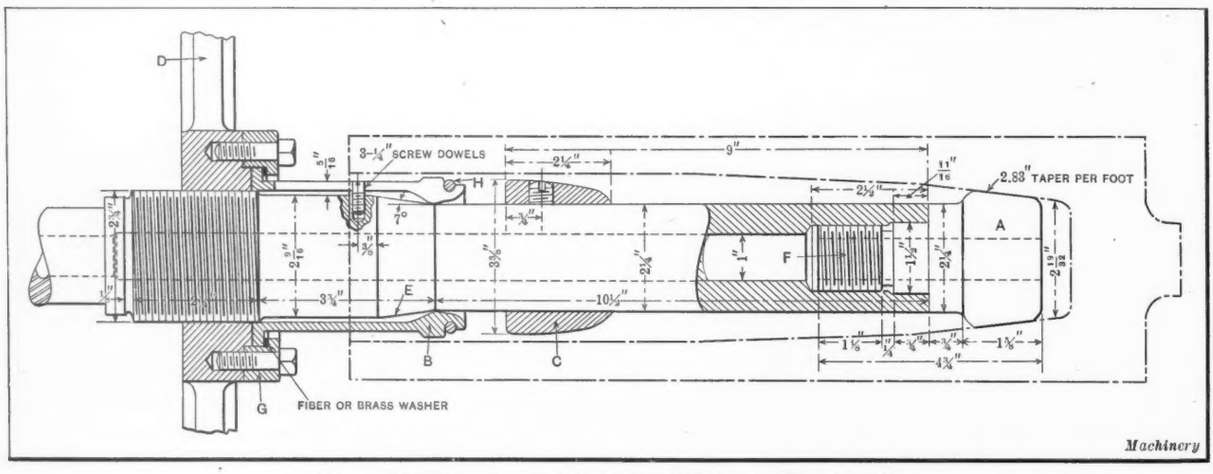


Fig. 5. Expanding Arbor used for holding Shell for Centering Operation

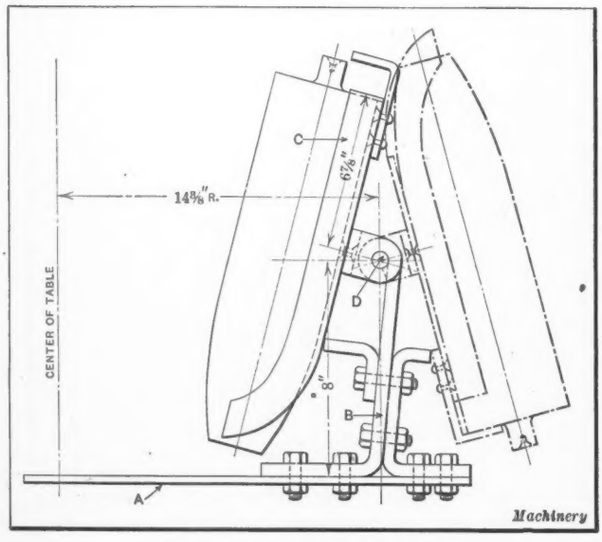


Fig. 6. Detail of Draining Fixture

end *A* of the arbor is screwed into the arbor proper as indicated at *F*. At *D* is shown a handwheel, the hole in which is provided with eight Acme threads per inch fitting over a plate on the arbor. This handwheel, through the medium of collar *G*, pulls the expanding bushing back when the device is in operation. A spring ring *H* pulls the bushing together when the shell is to be released, and the bushing is forced down along the taper *E*. The end *A* is made from low-carbon steel, casehardened; it is ground after having been assembled on the arbor in the lathe in which it is used. Collet *B* is made from high-carbon steel, hardened and ground on the surfaces that bear against the shell and the arbor. The collet contracting spring ring *H* is made from 3/16-inch spring wire. Collar *C* is made from low-carbon steel and casehardened. The collar or retaining ring *G* is made from tool steel and hardened. The arbor or spindle itself, is made from low-carbon steel. Handwheel *D* is made from cast iron.

Operation 9 (*H*, Fig. 1)—nosing the shells—is performed in a regular geared crank press having a 9-inch stroke, the press being provided with a cast-iron water-cooled die. For heating the shells previous to nosing, a Frankfort nosing

furnace having six holes is provided. The press is of 150 tons capacity; three nosing furnaces and one press take care of the capacity of the plant. The nosing die is shown in detail in Fig. 7.

Operation 10—heating and quenching—is one of the most interesting operations in the plant in that several devices are employed that differ considerably from those used for the same operations elsewhere. For the heating, a Frankfort oil-fired hardening furnace is used. The shells are heated to 1600 degrees F. for a period of seventy minutes. They are then quenched in Cataract No. 382 quenching oil. The quenching tank shown in Fig. 4 is provided with an interesting automatic device for moving the shells through the oil in the tank. The shells are first gripped by a kind of tongs having a hook-shaped handle and are then transferred from the furnace and hung by this hooked handle onto a screw *A* which is rotated over the center of the quenching tank by a worm *B* and a worm-wheel *C*. It is apparent that as the screw rotates it will gradually move the tongs with the shell held in them along the screw, the latter, in fact, acting as a kind of conveyor carrying the shells toward the right-hand end of the tank, where they are lifted up from the oil by an operator and placed in a draining fixture on a revolving table mounted on shaft *D* over the right-hand end of the tank.

A detail of the draining fixture is shown in Fig. 6, which consists of a revolving plate *A*, onto the periphery of which are attached ten shell-holders *B*. The operator standing beside the tank over which the draining fixture is mounted, places the shell onto a pivoted holder *C*, the position of this holder and of the shell being as indicated by the dotted lines, after which the operator swings the shell and holder around the pivot stud *D* until it occupies the position shown in full lines at *C*. The operator then turns the fixture to the next position, removes the shell that has been drained, and puts a new shell from the quenching tank into the fixture for draining. The fixture is built up almost entirely from bent pieces of band iron.

The second and last installment of this article will be published in the February number of MACHINERY.

* * *

THE RECLAMATION OF HACKSAWS AND METAL-CUTTING BAND SAWS

In the November, 1917, number of MACHINERY, page 242, an article appeared relating to the resharpening of files so that worn out files might be made practically as good as new. In the May, 1918, number another article appeared on the salvaging of reamers and milling cutters. The work of salvaging tools of this kind has been of great importance during the past years when steel has been so scarce. A practice that has been recently developed, which is equally important in its field, is the reclaiming of hacksaw and flexible-back metal-cutting band-saw blades. In the past, dull hacksaw blades and metal-cutting band-saws have been scrapped, as there were no means for economically resharpening them. Recently, machines have been developed for doing this work and thereby a great saving is accomplished. The unique feature that should be mentioned in this connection is that the resharpened hacksaw blade is claimed to be superior in cutting qualities to a new blade, the explanation for this being that when the new blade is hardened there is a thin decarburized layer of metal at the point of the tooth which will not be as hard as the remainder of the metal in the saw. When resharpened, this decarburized surface is removed and the fully hardened portion of the steel is brought into action. For this reason, a resharpened hacksaw requires the counterweight of the hacksaw machine to be set back so that there is less pressure on the tooth, as otherwise it will dig too deeply into the metal being cut.

Comparison between New and Resharpened Blades

As examples of the comparison between new blades and resharpened blades, tests made by the Warner Gear Co., Muncie, Ind., on four resharpened blades compared with the same number of new blades of the same make, will be of interest. The blades used were 18 inches long, 1 inch wide, 10 teeth to the inch, and made from No. 16 gage steel. The results with each of the four sets of blades were as follows:

1. Material cut, ⅞-inch round steel tubing with 5/32-inch wall; new blade, number of cuts, 75 to 80; resharpened blade, number of cuts, about 300.

2. Material cut, 1-inch round Bessemer steel. New blade, number of cuts, 40; resharpened blade, number of cuts 86.

3. Material cut, 5¼-inch round chrome-nickel steel of from 0.40 to 0.50 per cent carbon. New blade, made three cuts with an average time per cut of 1½ hour; resharpened blade made four cuts with an average time per cut of 1 hour.

4. Material cut, same as in experiment No. 3. Results obtained same as in experiment No. 3, except that in this case the resharpened blade made 4½ cuts.

Resharpening 400,000 Hacksaws

One large concern had been saving its worn out hacksaws for many years with the hope that some day some means would be developed whereby these might be resharpened. The war having accelerated the developments in many lines, the hacksaw sharpening machine made its appearance, and this firm wrote to the manufacturer laying its problem before him. It was estimated that the hacksaws, when resharpened, would represent a value of $100,000 and that the cost of sharpening them would not exceed from $20,000 to $25,000, leaving a profit of from $75,000 to $80,000. This gives a good indication of the advantage of reclaiming hacksaws as a purely commercial proposition.

How to Use Hacksaws Economically

In order to use hacksaw blades economically, they must be resharpened often. Just as soon as they show an indication of dullness they should not be run any longer, but should be sharpened. There is always an indication of loss of cutting power, so that the operator will know when it is time to resharpen. If the resharpening is systematically attended to, the life of the hacksaw will be materially lengthened. In England, it is the practice to draw the temper of hacksaws after they have been sharpened from six to eight times, after which they are reset, rehardened and resharpened, and then used over again as if new. This, of course, saves material to a great extent, as the saw can be used until there is very little left of the steel in it.

The length of time a saw can be used between resharpenings can be determined for different materials by experiments, and afterward, a standard time for resharpening may be indicated to the employes, so that their judgment as to whether a saw is dull or not need not be depended upon. On tough materials, for example, it would be necessary to regrind more often than on other materials.

In America, the practice of drawing the temper, resetting, and rehardening saws has not gained ground, but the English practice in this respect would be well worth following in many instances. On shell work a saw can be used for three or four grindings before the set is lost, but on soft steel, brass, and bronze it is possible to grind a saw from eight to ten times before the set is lost. In one instance cutting chrome-nickel steel with a band saw, it was found possible to resharpen the saw four times before the set was lost. This would also apply to hacksaws. When the set is lost it is, of course, impossible to regrind further, and the blades are thrown away, unless the English practice of drawing the temper, resetting, and rehardening is adopted. Of course, the question of resetting is a commercial one. If the cost of redrawing, resetting, rehardening, and resharpening is higher than the cost of a new saw, as it might be in normal times when steel is cheap and the material in the saw is a comparatively negligible quantity, this practice would not be economical. During the time of stress through which we have passed, however, with steel not only expensive but scarce, the British practice was commendable. E. O.

Dynamic and Static Balancing

Second of Two Articles on Conditions that must be Fulfilled in Balancing Machine Members, and Methods of Conducting the Work

BY EDWARD K. HAMMOND[1]

IN the preceding article on this subject, published in the December number of MACHINERY, the conditions which must be fulfilled in balancing machine members were explained, and a number of types of dynamic balancing machines were described. The following article gives additional information on dynamic balancing, and describes static balancing machines.

Balancing High-speed Pulleys

To provide for balancing pulleys, flywheels, and similar shaped machine members, the Defiance Machine Works, Defiance, Ohio, built for the market a dynamic balancing machine which is shown in operation in Fig. 9. This machine has a capacity for balancing parts which do not exceed one thousand pounds in weight. An operator may be quickly trained to produce accurate results through its use, as it is said to be merely necessary for him to have sufficient practice to gain the required knowledge of how to locate the light and heavy portions of the pulley or other machine member that is to be balanced, and then to remove metal at the proper points. In operating this machine, the method of procedure is governed to a certain extent by the size and shape of the part to be balanced. For the sake of discussion, suppose the part is a standard shaped pulley similar to that shown in position at *A*.

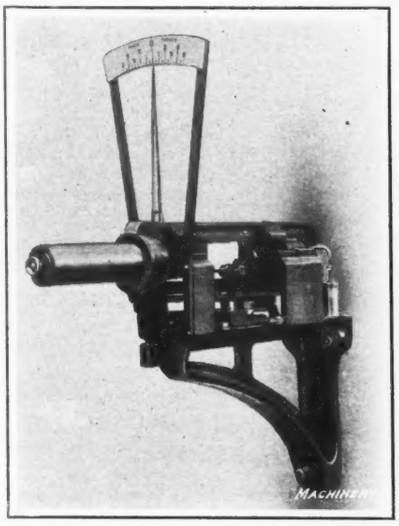


Fig. 8. Airplane Propeller Static Balancing Machine built by W. & T. Avery, Ltd.

The pulley or other machine member to be balanced has a plug secured in its bore, this plug having a conical shaped cavity at its lower end, which is located in the bored hole so that the conical cavity is slightly above the center of gravity of the work, thus enabling the piece to be supported on the point of the vertical spindle of the machine. Two fingers *B* are carried by a driver at the top of the machine spindle, and these fingers engage the spokes of the pulley to provide for driving it when the machine is started; then after the work has been given the proper momentum, the fingers drop away, leaving it freely supported on the conical spindle. After this has been done, the friction clutch is also disengaged to allow the machine spindle to come to rest. Under these conditions, the marking is done while the pulley or other member to be balanced is spinning freely on the conical point of the spindle. The cavity in the balancing plug, which fits over the pointed spindle, is slightly larger than the spindle so that the pulley is free to assume an axis of rotation through its center of gravity, instead of through the geometrical center; and when rotating under these conditions, the light and heavy sides may be discovered by applying marks according to the method described in the article in the December number. In starting to balance a pulley on this machine, a test weight made of molding clay is first applied inside the rim at a point near the center, the magnitude and position of the weight being such that the pulley will be brought into a condition of static balance, after which this machine is used to adjust the position of the weight in order to secure dynamic balance. The weight is composed of moist clay taken from the supply in cup *C*. This machine was designed by Charles Seymour, general superintendent of the Defiance Machine Works.

After the pulley is started rotating, the edge of the rim is marked with a pencil made of chalk or moistened clay. If the mark occurs within one-quarter of the circumference of the pulley from the position at which the weight was applied in the direction of rotation, the weight is raised toward the upper edge of the rim. If, on the other hand, the mark is more than one-fourth revolution from the weight, the position of the weight is lowered, after which the pulley is again started to rotate and another clay mark is made on its rim. If the weight should

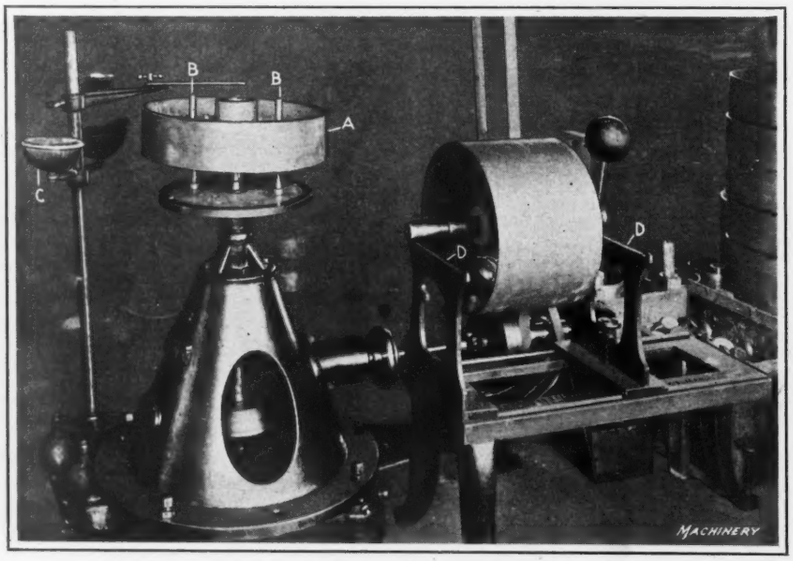


Fig. 9. Dynamic Balancing Machine built by the Defiance Machine Works for finding the Light and Heavy Sides of Pulleys; a Set of Static Balancing Ways are also shown at D in this Illustration

[1]Associate Editor of MACHINERY.

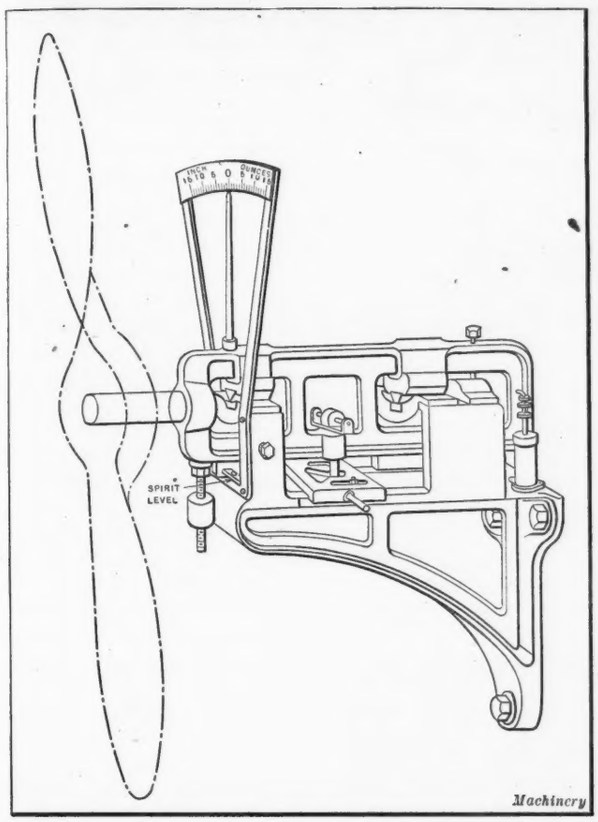


Fig. 10. Machine shown in Fig. 8 with Propeller in Place Ready to be balanced

reach the edge of the rim, and the pulley should still run out, it is obvious that the magnitude of the weight must be increased by placing a counterweight diametrically and transversely opposite. Care must be taken at every adjustment of the weights not to destroy a condition of static balance. In addition to its application for balancing pulleys, this machine is used for balancing a variety of similar members which are of approximately the same form and which are required to run at high rotative speeds.

After the positions of the heavy and light sides of the pulley have been determined, it is necessary to make the required correction, which may either be done by removing excess metal from the heavy side or by riveting a weight inside the rim of the pulley on the light side. In starting to balance a pulley, the required condition of static balance is secured by placing the pulley on balancing ways which are shown at *D* in the illustration. For this purpose, the pulley is mounted on an arbor that is accurately machined so that it will roll on the knife-edges of the balancing ways with little frictional resistance, in order to allow gravity to draw the heavy side of the pulley to the bottom. As stated in the preceding article on this subject, the obtaining of an accurate condition of static balance does not assure that a machine member has also been brought into dynamic balance. With a symmetrically shaped machine member such as a pulley, however, less trouble is likely to be experienced in dynamic balancing, if the work is first brought to a condition of accurate static balance.

Some Causes of Trouble in Applying Methods of Dynamic Balancing

It is probable that much of the trouble which has been experienced in applying practical methods of dynamic balancing has been due to the fact that engineers in those plants where such methods are used have endeavored to make the results of tests, upon which the actual work of balancing is based, conform with the accepted theories which have been evolved from scientific researches into conditions that must be fulfilled in order to bring a machine member into accurate running balance. Paradoxical as it may seem, general experience has shown that better results have been obtained where practical shop methods of dynamic balancing are applied by mechanics who have had practically no scientific or engineering education than has been the case where such methods have been used by fully qualified mechanical engineers.

Two theories may be advanced at this point, which have an important bearing upon the method of procedure in bringing a machine member into accurate dynamic balance, although they are somewhat at variance with accepted theories governing shop practice. In the first place, some authorities are inclined to believe that there is no such thing as "critical speeds," at which the amount of vibration set up through lack of balance in the running member is greater than at intermediate speeds. According to the exponents of this theory, the only reason for the apparent existence of critical speeds is that when the running member is driven at a speed which causes its vibration to synchronize with the period of vibration of the machine frame, there will naturally be a much more severe vibration than at speeds where the period of vibration of the running member and of the machine frame are not synchronous. There will, of course, be several speeds at which the maximum vibration effect is produced, that is, speeds where the period of vibration of the running member is equal to or an even multiple of the period of vibration of the machine frame. In many cases, the effect of vibration can be greatly reduced by providing a more satisfactory mounting for the machine or by stiffening the frame and by taking other steps in designing and erecting machines to assure freedom from vibration.

In bringing a machine member into a state of accurate running balance, it is quite a general practice to first bring the member into a condition of static balance. Some men who have made a study of the subject believe this method of procedure to be unwise for the following reasons: Consider the case of a cylindrical shaped member which has a heavy point at one end and another heavy point diametrically opposite at the other end of the cylinder. Such a member would be in static balance, but the condition would be such as to produce the maximum lack of dynamic balance, because centrifugal force acting upon these two heavy points would set up a torque that would tend to change the axis of rotation from the line of bearing centers to an axis through the center of gravity of the rotating member. For this reason, it is claimed that time spent in static balancing is practically wasted. On the face of it, this argument may be plausible, but as a matter of fact, most plants engaged in building steam turbines, automobile engines, and other machines requiring certain members to be brought into dynamic balance make a practice of first balancing such members statically. In the case cited, it is quite true that static balancing would have no effect in correct-

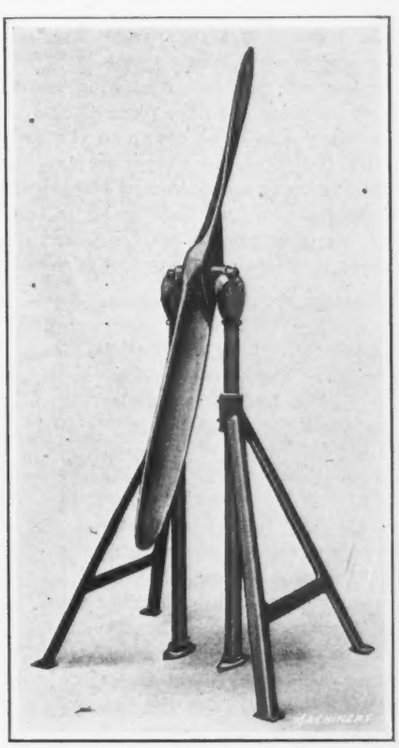


Fig. 11. Airplane Propeller Static Balancing Machine built by the C. Mattison Machine Works

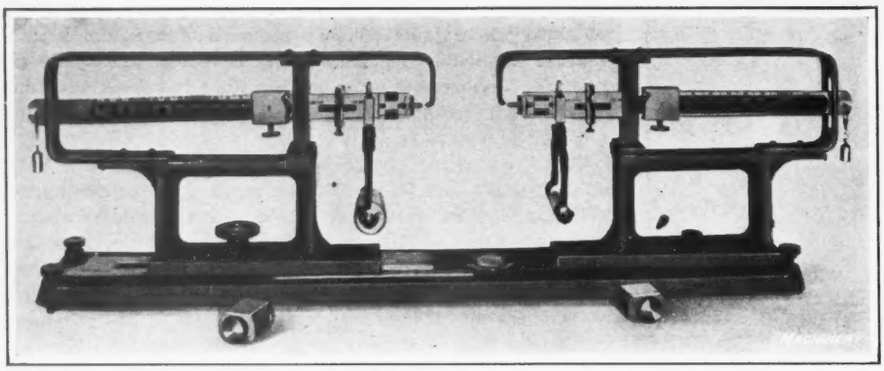


Fig. 12. Airplane Engine Connecting-rod Standardizing Machine built by W. & T. Avery, Ltd.

ing errors in dynamic balance, but would even accentuate the trouble. However, such a condition as that in which a cylindrical member has the two heavy points at opposite ends and diametrically opposed to each other is likely to be of unusual occurrence. In the general run of cases, where there is considerable lack of balance, the uneven distribution of mass will be such that the error will be revealed by the static balancing test, and most of the trouble can be removed before the machine member is put on the dynamic balancing equipment for making the final adjustments that are necessary to permit it to be run at high speed without setting up an abnormal amount of vibration and without causing an undue amount of wear and tear upon the bearings and other machine members.

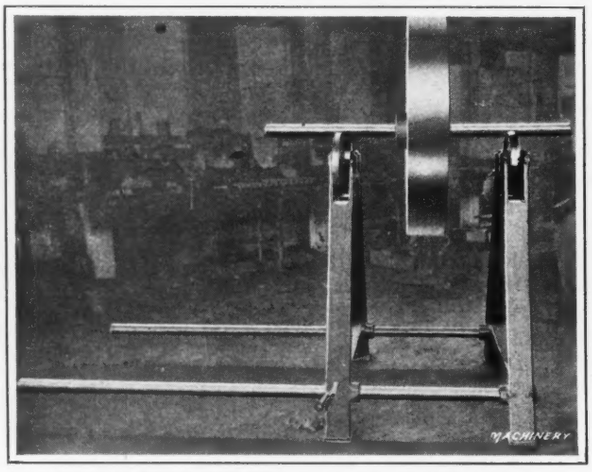


Fig. 13. Static Balancing Machine built by the Rockford Tool Co., having Adjustment for balancing Machine Members of Various Lengths

Methods of Static Balancing

From the preceding discussion the reader has doubtless realized that it is a much simpler operation to bring a piece into static balance than into dynamic balance. Various methods are used for this purpose, the problem consisting merely of supporting the work on some sensitive form of bearings which will enable the heavy side to be drawn to the bottom by gravity, after which the necessary correction may be made by drilling or grinding away metal from the heavy side. In the following discussion some methods of static balancing are explained and static balancing machines are described which have proved their practicability in the shops where they are used.

Airplane Propeller Balancing Machines

Experience has shown that under the conditions of service for which military airplanes are used, the average life of an engine for one of these machines is only two months. This severity of service makes it especially important for the propeller and other rotating parts of the engine to be accurately balanced in order that all the parts of the mechanism may be relieved from unnecessary strains. Any slight excess of weight in either of the propeller blades will produce an unbalanced centrifugal force which will give rise to unpleasant and possibly dangerous vibration, in addition to lessening the durability of the engine. In Figs. 8 and 10 there is shown a static balancing apparatus built by W. & T. Avery, Ltd., Birmingham, England, which consists of an oscillating beam fitted with hardened steel knife-edges that rest on hardened bearings carried by a cast-iron bracket bolted to the wall or some other vertical support. Projecting from the beam, there is an accurately turned spindle which is so arranged that its axis may be brought into accurate alignment with the knife-edges.

A loose gun-metal sleeve is fitted over the spindle and is turned to suit the bore of the propeller, which is threaded onto the sleeve and can be set at different angles in order to ascertain if any portion is unbalanced relative to the axis of rotation. If such is the case, the beam will be deflected to the right or left, as the case may be, and an indicator attached to the beam will show the magnitude of error in inch-ounces or centimeter-grams, as desired. Where such an error is discovered, the form of the propeller must be corrected before the propeller is put in service. Provision is made for locking the beam while the propeller is being screwed onto the spindle, and a small adjustable dashpot is used to overcome any unnecessary oscillation, and thus bring the beam to rest in a minimum amount of time. With this apparatus, an operator can soon learn to judge the amount of material to be removed from the blades in order to correct the error in balance and enable the propeller to rotate with a minimum amount of vibration. The correction for lack of balance can be made without removing the propeller from the balancing machine, thus affording the operator a chance to constantly observe the effect of his work.

Fig. 11 shows an airplane propeller balancing machine built by the C. Mattison Machine Works, Beloit, Wis., to meet the same general requirements for which the Avery

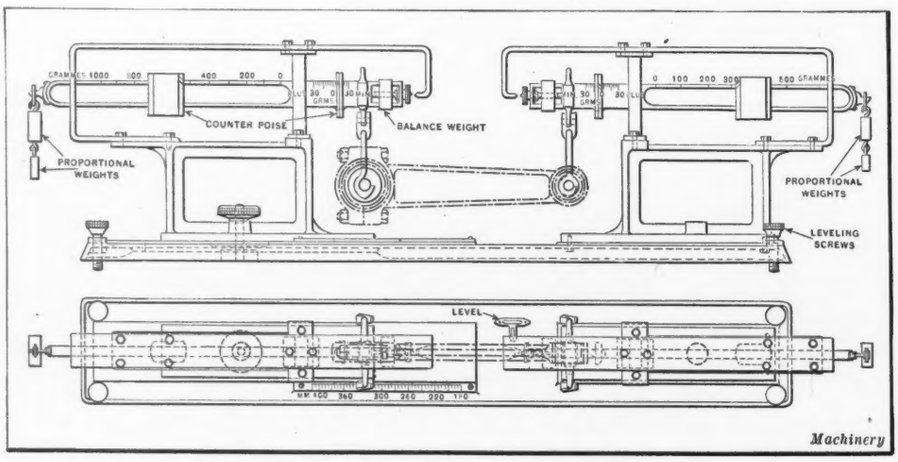


Fig. 14. Machine shown in Fig. 12 with Connecting-rod supported on Knife-edges for the Standardizing Operation

apparatus was developed. It will be apparent from this illustration that the Mattison machine is furnished with two pairs of disks which support each end of a stud on which the propeller is mounted during the time the test is being made. These disks are mounted on ball bearings to assure the maximum sensitiveness, and in the event of any lack of balance in the propeller, gravity will carry the heavy end down, thus indicating the inaccuracy which must be corrected. This is a simple tool requiring no adjustment, so that it is always ready for use. The disks are accurately ground and faced, and the ball bearing pivots make the machine sufficiently sensitive to assure obtaining the accurate results required in balancing airplane propellers.

Standardizing Machine for Airplane Connecting-rods

Owing to the high speed at which airplane engines are required to run, it is important for all of the connecting-rods to be of exactly the same weight in order to avoid trouble from vibration. Machining the rods all over does not afford adequate assurance of accurate balance, because there may be variations in the density of the metal at various points in the forgings. Figs. 12 and 14 illustrate a duplex apparatus built by W. & T. Avery, Ltd., for the purpose of simultaneously standardizing the weight of both ends of airplane connecting-rods. The purpose is to eliminate lack of balance, which would seriously affect the smooth running properties and durability of the airplane engine. In using this balancing device, a standard connecting-rod is first put into place with the knife-edge mandrels fitted into the bore at each end of the rod. An adjustable frame carrying one of the steelyards is next set to a graduated scale upon the base, at such a distance from the other frame that the centers of the two mandrels correspond to the measurement between centers of the bores of the connecting-rod. With the standard rod suspended from the back knife-edges of the steelyards, the weight is balanced by moving the large counterpoises along the scale arms. During this time, the small counterpoises are set in their respective zero positions. A connecting-rod to be tested is next put into position in place of the standard rod and any difference in weight from the standard connecting-rod is shown by the positions to which the small counterpoises must be moved at either side of their zero positions, that is to say, plus or minus. In case errors are discovered, the machine shows the magnitude of the errors and facilitates the work of making corrections.

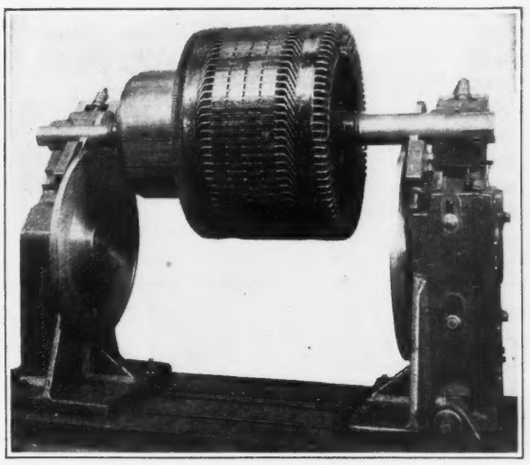


Fig. 15. Sensitive Type of Apparatus developed by the Westinghouse Electric & Mfg. Co. for bringing Rotors into Static Balance

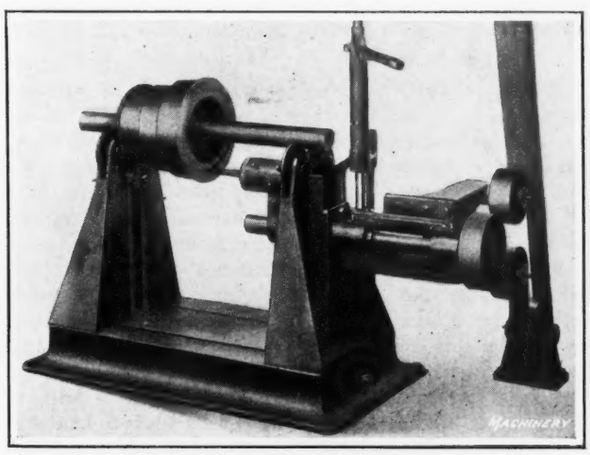


Fig. 16. Combination Static Balancing and Drilling Machine built by the Rockford Tool Co.

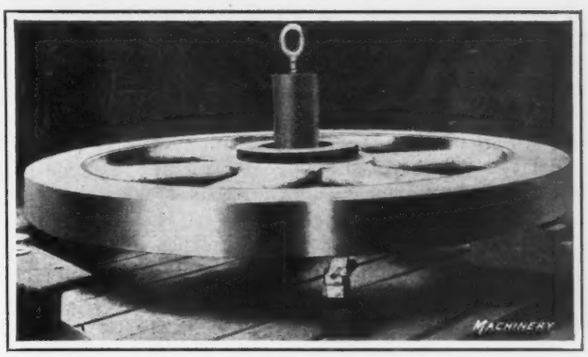


Fig. 17. Stand shown in Fig. 18 with Large Flywheel in Place Ready for performing the Static Balancing Operation

In order to provide for balancing different sizes of connecting-rods, provision is made for adjusting the frames that carry the steelyards along the base of the machine. In this way, sufficient adjustment is furnished to provide for testing connecting-rods ranging from 7½ to 16 inches between the centers of the bores at opposite ends of the rod. It will be of interest to note that the base is made of cast iron, the steelyards of gun-metal, and the knife-edges of hardened steel, resting on agate bearings. The steelyards are graduated to 64 and 32 ounces, respectively, for the major graduations; and the minor graduations run from zero up to one ounce, plus or minus. If the required capacity exceeds the capacity of the steelyard, loose proportional weights are provided to be suspended at the ends of the respective steelyards furnished on the machine.

Rockford Tool Co.'s Static Balancing Machine

In Fig. 13 there is shown a machine built by the Rockford Tool Co., Rockford, Ill., which is adapted for bringing various machine members into an accurate condition of static balance. Reference to this illustration will show that the machine is provided with two sets of double disks on which the arbor is carried that supports the pulley or other machine member to be balanced. These disks are carried by sensitive anti-friction bearings so that they turn freely to enable the heavy side of the work to run to the bottom. It will be seen that one of the housings of this machine is provided with means of adjusting its position in a horizontal direction in order to provide for balancing pieces of various lengths. After the heavy side has been determined, the metal is removed by drilling, and the work is then taken back to the machine and again tested for balance. Subsequent tests are made in this way until a condition of accurate static balance has been obtained.

The Rockford Tool Co. also builds a machine of somewhat similar type, which is shown in Fig. 16. It has a horizontal drilling spindle incorporated in the construction of the balancing machine. This spindle is situated opposite the lowest position on the work so that the drill may be fed into the work after the heavy side has been located, in order to provide for removing metal to obtain a condition of static balance. A combination machine of this kind saves the loss of time involved in changing the work back and forth between an independent drilling and a balancing machine, thus enabling the balancing operation to be more rapidly performed.

The chilled iron disks on which the arbor is carried are pivoted on shafts carried by ball bearings. These bearings are especially designed with the ball contact close to the center, in order to make them as sensitive as possible. Up and down adjustments of the complete drill head and anvil are provided in order that work ranging from 3 to 36 inches in diameter may be handled on the machine. A number of automobile and tractor manufacturers are using this combination machine for balancing motor flywheels. Machines of this type are also adapted for use in balancing cone pulleys, electric motor armatures, crankshafts, and similar machine members. They may be equipped for either belt or individual electric motor drive, and different sizes of machines are made for handling various classes of work.

In Fig. 15 there is shown a modification of this type of machine which is successfully used at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., for use in balancing large rotors of electric generators and motors, steam turbines, and similar apparatus. This machine is provided with a pair of large disks that are mounted on anti-friction bearings and beside each large disk there is one of smaller diameter, the position of which may be adjusted in order to provide for supporting shafts of various sizes. When this machine is used for balancing pulleys or similar pieces which are not mounted on a shaft, they may be placed on an arbor while the balancing operation is being performed. The arbor is placed on top of the large disks and rests lightly against the small disks. The position of the small disks is then adjusted so that the point of contact with the shaft or arbor will be located only about one degree from a vertical line passing through the center of the large disk. Supported in this way it is easy for the shaft to rotate with a minimum amount of friction and with practically no wedging action. Then when the heavy side of the work has been found, correction may be easily applied.

"Umbrella" Type of Balancing Fixture

In Figs. 17 and 18 are shown what is known as an "umbrella" type of static balancing fixture and a large flywheel set up on a fixture of this type. This method of static balancing is also used by the Westinghouse Electric & Mfg. Co. The fixture consists of a hardened steel ball ¾ inch in diameter which is carried in a hardened and ground cup of slightly larger diameter, cut in the top of a pedestal. The machine member to be balanced has a mandrel secured in its bore, which has a cup of similar shape cut in its lower end. The steel ball is placed in position in the cup at the top of the pedestal and then the machine member to be balanced is supported by placing the cup in the lower end of the mandrel over the hardened steel ball. Held in this way the heavy side will at once be revealed by its tendency to seek a lower level, and it is merely necessary to remove metal from the low side until a satisfactory level is obtained. The sensitiveness of this apparatus assures obtaining an accurate condition of balance.

Fig. 18. "Umbrella" Type of Static Balancing Stand used by the Westinghouse Electric & Mfg. Co.

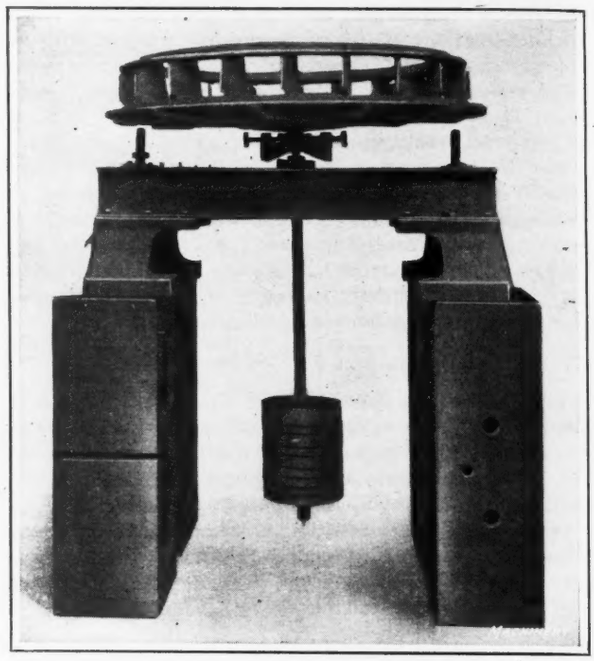


Fig. 19. Static Balancing Machine provided with Pivoted Turntable on which Heavy and Light Sides of Work are located. This Machine is used by the Westinghouse Electric & Mfg. Co.

Balancing Built-up Rotors

Where it is necessary to balance a rotor which is built up from several disks, the Westinghouse Electric & Mfg. Co. has found it desirable in certain cases to handle the work by balancing each disk separately. An excellent apparatus for performing such operations is shown in Fig. 19. It will be seen to consist of a turntable mounted in such a way that it may be rotated on a beam, while this beam is, in turn, supported by two knife-edges that rest in self-aligning sockets upon a supporting base. The counterweight is adjusted so that the center of gravity of the portion of the apparatus carried by the knife-edges is located just below the plane of these knife-edges. When the turntable supporting the part to be balanced stays in a horizontal position during a complete revolution of the work, it indicates that the required condition of static balance has been obtained. The horizontal position of the table is determined by means of a pointer.

* * *

It has occasionally been claimed that pneumatic tools are responsible for producing certain nervous diseases in the user. In an investigation, the results of which were presented before the seventh annual safety congress of the National Safety Council, it was found that pneumatic tools have no detrimental effect on the nervous system or general health of the user. The only trouble directly attributable to the use of pneumatic tools is a disturbance of the function of the left hand, known as "white" or "dead" fingers, which occurs in some users during the cold weather. To overcome this condition it is recommended that the tool be warmed in cold weather before and while using; that the shank be enlarged so that the worker can grip it without causing finger cramp; that the user wear gloves; and that the prevalent custom be discontinued of blocking the exhaust outlet and thus forcing a draft of chilled air out along the tool and onto the fingers of the left hand.

TOOLS FOR BORING A CLOSED-BOTTOM SHELL

TYPES OF BLADES USED IN BORING HEADS AND METHODS OF GRINDING AND SETTING THE BLADES

BY M. H. POTTER

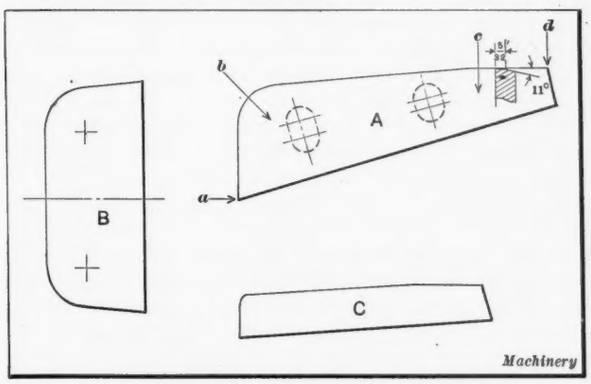


Fig. 1. Types of Blades used in the Boring Head

PROBABLY the most difficult operation in machining closed-bottom shells is that of boring. On account of the closed bottom and the combination of straight bore, taper bore, radius, and flat surfaces, this particular shaped shell is especially difficult to machine. Not only are the boring tools as here described of note, but the grinding fixture and the gage for setting the blades are also of especial interest. The latter are most important for rapid and steady production at a minimum cost. The tools described

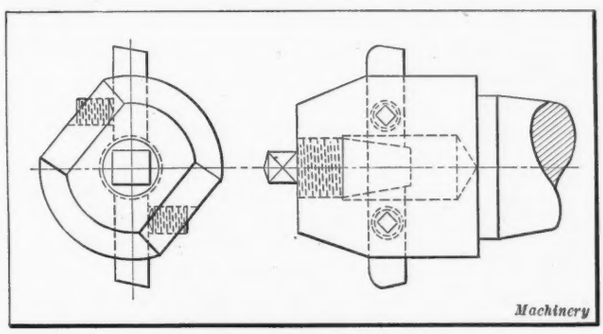


Fig. 2. Ordinary Type of Two-blade Boring Head

in this article are used in the production of shells from the 3-inch, or 75-millimeter size, up to and including the 6-inch shell.

Types of Blades Used in Boring Heads

Various styles of blades have been found satisfactory for the boring tools, and no doubt each has its own special features and adaptabilities. While some may prefer one style, others favor another type. The blades shown in Fig. 1 illustrate some of the different types in detail, and the illustration may serve for a general description of the various blades in use. The blade shown at *A* is probably the best

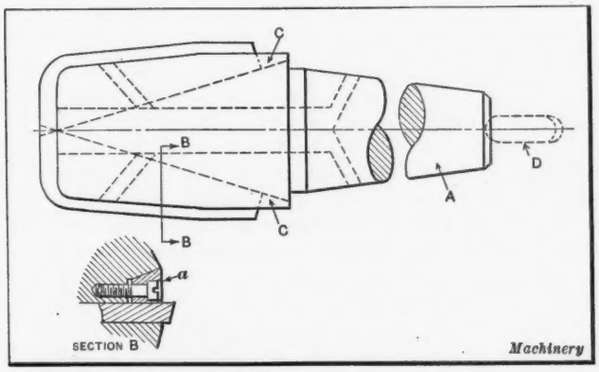


Fig. 3. Boring Head used for forming the Contour of the Shell

type from a general point of view. It is held in the boring head by means of a taper strip and fillister-head machine screws. Each of the different styles of blades shown are shimmed up to size for boring the proper diameter and form, and referring to the blade at *A*, are ground with the following clearances: from *a* to *b*, 7 degrees; from *b* to *c*, 11 degrees; the straight part from *c* to *d*, from the top of the cutting edge to 5/32 inch below it, 4 degrees; and the remainder, 11 degrees. These clearance angles apply to the British 6-inch high-explosive shell. They were obtained from actual experiments and produce a smoothly bored shell. The blades are ground to a thickness of 0.500 inch and are a sliding fit in the slots in the boring head. A blade that is identical with that shown at *A* but having two holes, as shown dotted in the illustration, is sometimes preferable. This type of blade is held in place by means of two ½-inch fillister-head machine screws. The principal objection that many have to this style of blade is that the slotted holes

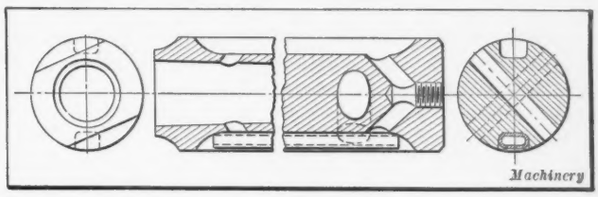


Fig. 4. Boring-bar with Provision for supplying Cutting Compound to the Boring Head

weaken the blade and tend to cause breakage. Two blades are required in the boring head for either of the styles shown at *A*.

The blades shown at *B* and *C* represent a somewhat different type of construction. One blade *B* and two blades like that shown at *C* are required in each boring head. *B* is the front blade and is held in its slot by a ⅝-inch fillister-head machine screw. The blades *C* are held by a clamping strip similar to that shown at *a* in the illustration of the boring head, Fig. 3, and are placed at right angles to the front blade *B*. Although this style is not as simple as either of the other forms, it has given satisfactory results, its particular advantage being that the blades, which are smaller, are somewhat cheaper to replace.

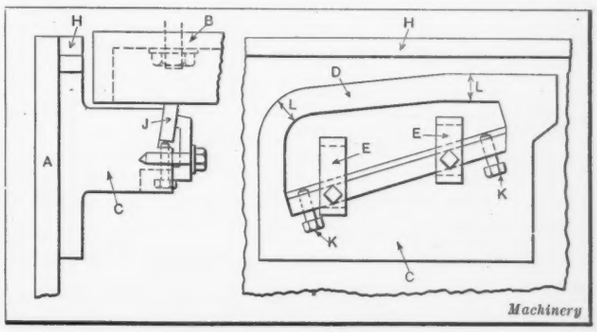


Fig. 5. Form Block Grinding Fixture

Figs. 2 and 3 illustrate types of boring heads which have proved to be very dependable. The notable features of these styles are simplicity of operation and replacement, and exceptional wearing qualities. Fig. 2 shows the ordinary two-blade boring head with single-pointed tools, used for roughing the straight part of the bore. Fig. 3 shows the type of boring head used for roughing the contour and finishing to size. The two heads are very similar, the only difference being that old finishing blades are notched and used in the head for the operation of roughing the contour. The taper of the tang *A*, should be a little greater than the standard

Morse taper. If this point is observed, any wedging due to making the heavy cut at the bottom of the shells will be prevented. The taper of the tang serves to center the boring head while a standard tapered key, which is not shown in Fig. 3, is used in the tapered slot for holding the tool against the cut. The other tapered slot *D* is machined in the boring-bar and used for driving off the boring head.

The boring-bar shown in Fig. 4 is the culmination of much careful study and thoughtful designing. The sectional views show the general arrangement and construction. Attention is called to the method of supplying the cutting compound fluid to the boring head, by means of brass tubes. These tubes are ¾ inch outside diameter and were hammered into place in the groove or spline and then soldered. The correct method of procedure in making this bar, in order to secure the accuracy which is necessary to bore a shell within the required limits, is as follows: First, center the stock, and then bore out and ream the tapered hole for the tang of the boring head; next, center the bar using a mandrel driven in

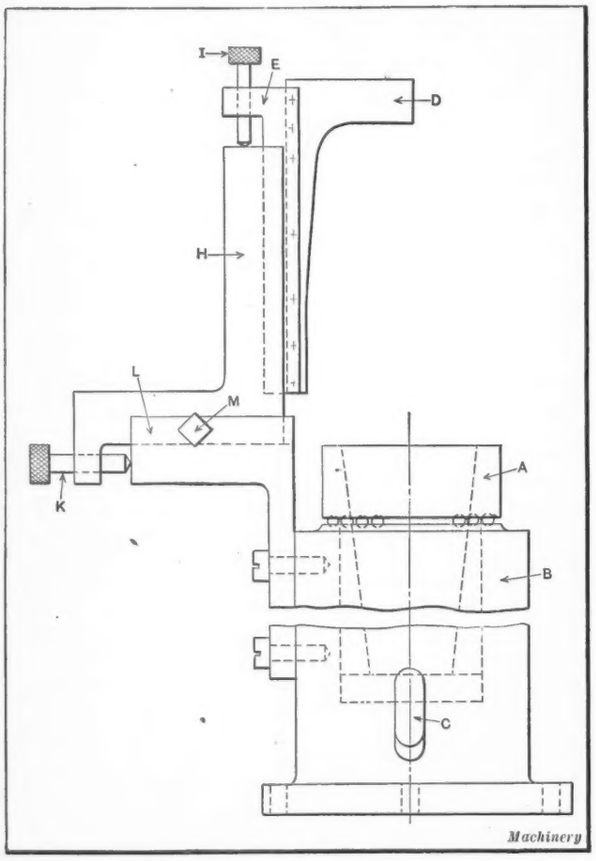


Fig. 6. Blade Setting Gage for Boring Head

at the tapered hole and using the old center at the opposite end; then turn or grind the outside of the bar to the required diameter.

Grinding and Setting the Blades

The form block grinding fixture, Fig. 5, is used for grinding and regrinding the roughing and finishing contour blades shown at *A*, Fig. 1, after they are first roughed to shape on a shaper. The plate *A*, Fig. 5, is bolted to an old-style plain grinder, and a dished wheel *B*, 10 inches in diameter, is used for the operation. The form block *C*, which has the same contour as the blades at its edge *D*, is slid along the straight strip *H* during the grinding operation. The clamps *E* hold the blades securely in position, as shown in the end view, *J* being the blade as it appears clamped in the block *C* and held in position against the grinding wheel. The two adjusting screws *K* maintain a constant and equalized distance between the blade being ground, and the form or profiling block *C*. The distance is represented by *L*, and by the method described a true contour is obtained.

When setting up the work a gage is used to permit quick adjustment. One of the most important parts of this fixture, which must be accurately machined, is the angular surface that forms the seat for the blade and to which it is clamped. Special attention should be paid to this, so that when the blade is ground the same clearances will be obtained as were explained in the description of methods used in grinding clearances for blades. This fixture will be of especial interest to those who have been grinding clearances by hand, as correct clearance angles on the cutting edge are the only solution of the problem for producing properly and smoothly bored shells. The use of this fixture eliminates, to a great extent, subsequent correcting of the bore.

The gage for setting the blades in the boring head after they have been ground is illustrated in Fig. 6. The piece *A* which is tapered inside to fit the taper of the boring head tang, is mounted on balls and fits into the base *B*. This base is slotted as shown at *C*, which facilitates removing the boring head by the use of a tapered key. The form gage proper *D* is riveted to *E*, which, in turn, is held in the piece *H* and seated in a V-slot. Vertical adjustment for *D* is obtained by means of the knurled-head screw *I*, and likewise, the horizontal adjustment along the V-slot *L* is furnished by means of the screw *K*. The set-screw *M* locks the gage when the proper horizontal adjustment has been made. It should be noted that the horizontal movement of *H* must be sufficient to allow putting the boring head on and taking it off. When the blades are placed in the slots in the boring head, they are shimmed out to the proper diameter, a snap gage being used to determine the diameter at the straight part of the blades. This fixture is easily adjusted and insures the correct contour for the blades; in addition, if a little care and judgment are exercised, the blades may be located so that each will have an equal amount of cutting to do, thus preventing the tool from chattering.

* * *

CHICAGO SHOP TRAINING SCHOOL

A training school for unskilled labor has been established in Chicago and, according to *Automotive Industries*, upon its success will probably depend the establishment of a number of other similar schools. The skilled labor market in Chicago has been seriously depleted by the call for highly trained operators by other cities. Due to the competition among Chicago plants for skilled labor on machine tool work, investigation has shown that the labor turnover is very high, and that employes are traveling from one concern to another, oftentimes in circles, under the influence of higher wage offers. This industrial condition exists, of course, not only in Chicago, but also in other cities. The idea of a training school was placed before the different manufacturing and trade associations of the city, and also before the chairman of the Section on Industrial Training for the War Emergency Advisory Committee, Council of National Defense. The cooperation of the Chicago Board of Education was enlisted, and this board decided to appropriate $10,000 for teachers and to arrange for building a school for the work, in the manufacturing district of the city. Several manufacturers are donating machine tools, duplicates of the machines that they are using in their plants, and upon which employes sent by these manufacturers to the school will perform the same operations that they will be expected to perform when they have finished their course and have returned to the factory. Besides furnishing machine tools, equipment, and sending men for training, manufacturers who take advantage of this school are required to permit their foremen and other skilled workers to give some of their time to the school as instructors. It is the understanding that, having completed their courses, the workers will return to the factory from which they were sent. Unskilled help may attend the school without having previously worked in any factory. Night classes are to be established so that those who are working in a factory in the daytime may take the school course after hours, and thus increase their efficiency and earning capacity.

Problem of the Theoretically Correct Involute Hob

BY NIKOLA TRBOJEVICH

MILLIONS of gears are cut by the hobbing generating method in this country annually. While it is generally conceded that, so far as production is concerned, the hobbing method has firmly established itself, it is often stated, especially by the advocates of the other methods of gear-cutting, that hobbed gears are inferior in quality to the planed, shaped, or form-cut gears. However, this is always traceable to deficiencies found either in the hob, the hobbing machine, or to the method of setting up and operating the machine, because the hobbing method has no inherent weakness that would prevent it from being used in the production of the highest quality of gears. It is the writer's opinion that hobs can be, and will be, in the near future, made to produce gears which will be as accurate as those produced by any other known method.

It must be understood that the theory of gear-hobbing is one of the most difficult propositions in the whole field of engineering, and as the method is comparatively new, there has naturally been no time or opportunity in which to place it on a solid scientific foundation. The time is approaching, however, when nothing but the best can survive, and when the old approximative ways of designing and calculating hobs must be discarded, and means must be found to make hobs not only approximately but absolutely correct.

The design of hobs at present is based on the theory of the "imaginary or equivalent rack." It is assumed that the generating action of a hob is equivalent to the action of a rack which has the same pitch and form of tooth as the normal section of the hob. That this theory is incorrect, and that it is an approximation only at best, can easily be visualized in the following manner: The teeth of the involute rack have straight sides; so also should, therefore, the involute hob on its normal section, irrespective of the thread angle. Suppose, now, that we increase the thread angle of the hob, either by reducing the diameter or by employing several threads, beyond all limits, to 90 degrees. In that case, the lead of the hob becomes infinite, and the threads of the hob become parallel to the axis, that is, the hob is then actually a spur gear; but, according to our supposition, the teeth are straight on the normal section, which is the section perpendicular to the axis. This gives us a straight-toothed profile, similar to a silent chain sprocket, which could not possibly generate involute gears. The rack theory is, therefore, incorrect.

A hob is not a rack by any means, nor is it equivalent to a rack in its generating action. The normal profile of the hob must evidently be some curve which can be defined in the terms of pitch, pressure angle, diameter and thread angle of the hob. It is the purpose of this article to deduce the equation and other properties of the surface of a theoretically correct hob, and suggest practical means by which such surfaces can be accurately calculated and produced.

Interchangeable Involute Gears

An interchangeable system of involute gearing comprises all the spur and spiral gears (we will omit the internal gearing in order to simplify matters) of any angle, hand, and number of teeth which can be generated by a particular involute rack. All these gears will be interchangeable, and will not only mesh correctly with each other, but, under certain conditions, will also be able to generate each other. Thus, if we have only one gear of the system, we can reproduce the others by a purely generating action. The generating rack must, of course, satisfy the conditions laid out by the Sang theory, namely, that the thickness of the tooth must be equal to the width of space, the working depths above and below the pitch line must be the same, and finally the tooth must be symmetrical.

All involute spur and spiral gears which have the same normal pitch, normal pressure angle, and working depth are interchangeable, and will generate each other. They will generate on each other correctly that part of the tooth surface which extends from the base cylinder to the outside cylinder, that is, the whole contact surface of the tooth, while the portion of the tooth surface which lies below the base cylinder will be completely generated only by the rack. In the case of any other member of the system being used for generating, for example, a pinion, as on the gear shaper, the portion of the surface below the base cylinder will only be incompletely generated. This difficulty can best be overcome by increasing the depth of teeth below the pitch line in order to provide sufficient clearance for any gear of the system, and that is what has been done in the example previously mentioned.

In developing a hob that will fit into a particular interchangeable system, the hob must be made to generate any gear of the system, and must, in turn, be capable of being generated by any single gear of the system. This is a practical way of determining the correct form of the hob tooth. As any member of the system may be chosen for the purposes of generating, we will choose the rack, as it is, mathematically, the simplest of all. The involute rack is a series of equidistant parallel planes. The generating action of one plane at a time will be considered in order to arrive at comparatively simple mathematical expressions.

Generating an Involute Surface

When the rack and the hob are meshing, the rack is moving with a uniform velocity in some direction while the hob is rotated uniformly. Suppose that the rack (now a plane only) is moving in the direction of the axis of the hob, and that the ratio of velocities is such that during one revolution of the hob the rack will advance a distance equal to the lead of the hob. This particular motion is general in its generating effect, for if the plane moved in some other direction than axial, it would always be possible to resolve that motion into two components, one in the axial direction and the other in the moving plane. The latter component has no influence on the shape of the generated (enveloped) surface, as such motion can only cause a sliding of the plane over the surface, but does not generate. As previously stated, the plane (which intersects the axis of the hob at a constant angle) is moving along the axis of the hob (see Fig. 1), while the hob is rotated with a uniform velocity. It can also be assumed, without affecting the conditions of generating in the least, that the hob is standing still, and the plane performs both motions, the axial and the rotary. Evidently, then, each point of the moving plane will describe a

helix about the axis Z. All these helixes will have the same lead but different thread angles, according to their respective distances from the axis. Now, there is one helix of particular importance, and that is the helix which osculates[1] the moving plane at every instant. This helix will be the so-called "edge of regression" of the surface generated by the plane.

The thread angle of the osculating helix must be equal to the slope of the moving plane with respect to the plane X–Y (Fig. 1). Thus, if the lead of the hob, and the angle of the rack-plane are given, the radius of the cylinder upon which the osculating helix is wound may be computed from the following relation:

$$a = \frac{l}{2\pi \tan \gamma} \qquad (1)$$

where a = radius of base cylinder;
l = lead of gear;
γ = thread angle of base helix, or slope of moving plane to plane X–Y.

The surface of the theoretically correct spiral gear is the envelope surface generated by the moving plane which inter-

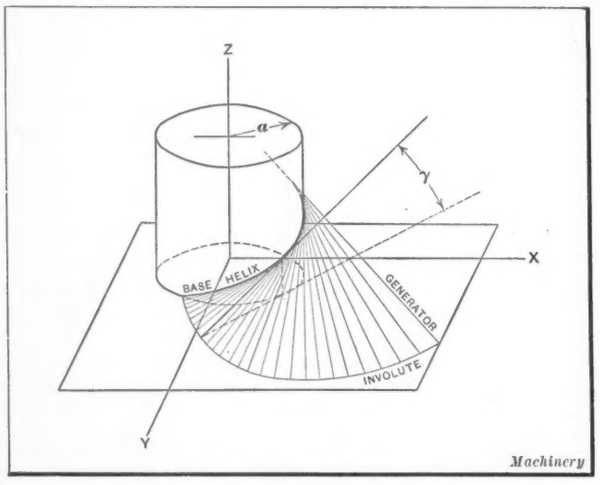


Fig. 1. Involute Spiral Tooth Surface

sects the axis Z under a constant angle at every instant. The osculating helix, or, as it may be called, the base helix (see Fig. 1) is an important curve on the surface, because the surface can also be swept by a straight line, rolling on the base helix. Let the equation of the base helix be:

$$X = a \cos \mu \qquad (2)$$
$$Y = a \sin \mu$$
$$Z = \frac{l}{2\pi}\mu$$

where μ = a parameter (angle) selected so that the helix passes through the point $X = a$, $Y = 0$, $Z = 0$.

Then the equation of the osculating plane to the curve can be written in the following determinant form:

$$\begin{vmatrix} x - X & y - Y & z - Z \\ \frac{dX}{d\mu} & \frac{dY}{d\mu} & \frac{dZ}{d\mu} \\ \frac{d^2X}{d\mu^2} & \frac{d^2Y}{d\mu^2} & \frac{d^2Z}{d\mu^2} \end{vmatrix} = 0$$

where x, y, and z are the current coordinates of the moving plane. Substituting for the values of X, Y, Z, and their derivatives from (2):

$$\begin{vmatrix} x - a\cos\mu & y - a\sin\mu & z - \frac{l}{2\pi}\mu \\ -a\sin\mu & a\cos\mu & \frac{l}{2\pi} \\ -a\cos\mu & -a\sin\mu & 0 \end{vmatrix} = 0$$

and solving the determinant, we get:

$$x\sin\mu - y\cos\mu + \frac{2\pi a}{l}z - a\mu = 0 \qquad (3)$$

Equation (3) is that of the moving plane, and contains the variable parameter μ. In order to obtain the equation of the envelope surface from (3), we differentiate with respect to μ:

$$x\cos\mu + y\sin\mu - a = 0 \qquad (4)$$

Equations (3) and (4) taken together give us the desired surface of the involute hob, or what amounts to the same thing, the equations of a spiral gear surface. The two equations can be combined into one by eliminating the parameter μ from both. This can conveniently be done in the following operations:

Multiply (3) and (4) by the sin μ and cos μ, respectively, and add:

$$x\sin^2\mu - y\sin\mu\cos\mu + \frac{2\pi a}{l}z\sin\mu - a\mu\sin\mu = 0$$
$$x\cos^2\mu + y\sin\mu\cos\mu - a\cos\mu = 0$$

$$x = -\sin\mu\left(\frac{2\pi a}{l}z - a\mu\right) + a\cos\mu \qquad (5)$$

Similarly, multiply (3) and (4) by cos μ and sin μ, respectively, and subtract:

$$x\sin\mu\cos\mu - y\cos^2\mu + \frac{2\pi a}{l}z\cos\mu - a\mu\cos\mu = 0$$
$$x\sin\mu\cos\mu + y\sin^2\mu - a\sin\mu = 0$$

$$y = \cos\mu\left(\frac{2\pi a}{l}z - a\mu\right) + a\sin\mu \qquad (6)$$

Squaring (5) and (6) and adding, we get the equation:

$$x^2 + y^2 = \left(\frac{2\pi a}{l}z - a\mu\right)^2 + a^2 \qquad (7)$$

from which

$$\mu = \frac{2\pi}{l}z \pm \frac{\sqrt{x^2 + y^2 - a^2}}{a} \qquad (8)$$

Substituting in (4) the equation of the surface is then:

$$x\cos\left(\frac{2\pi}{l}z \pm \frac{\sqrt{x^2 + y^2 - a^2}}{a}\right) +$$
$$y\sin\left(\frac{2\pi}{l}z \pm \frac{\sqrt{x^2 + y^2 - a^2}}{a}\right) - a = 0 \qquad (9)$$

Analysis of Involute Tooth Surface

1. *The surface is ruled and developable.*—Proof: The equation of the moving plane (3) contains one parameter only, the μ. In any text-book on differential geometry, a formal proof can be found that a one-parameter family of planes must generate a developable surface if any, and, of course, a ruled one, as every developable surface is necessarily ruled.

2. *The generating plane is tangent to the surface along a straight line, that is, the generator, and is osculating to the edge of regression which is, in this case, the aforesaid base helix.*—The equation of a particular generator can be had by substituting in Equations (3) and (4) any particu-

[1]The osculating plane of a twisted curve at a point is the plane containing the tangent and the principal normal of the curve. In the case of a plane curve, the osculating plane coincides with the plane in which the curve lies.

lar value of μ. Thus, for $\mu = 0$, the two equations become:

$$-y + \frac{2\pi a}{l} z = 0, \text{ and } x = a \qquad (10)$$

We will prove that all generators are tangent to the base helix. The equation of a tangent to any curve can be written in the following general form:

$$\frac{x - X}{dX} = \frac{y - Y}{dY} = \frac{z - Z}{dZ} \qquad (11)$$

where X, Y, and Z denote the coordinates of the curve.

Substituting for X, Y, and Z and their derivatives (with respect to μ) from (2), the equation of the base helix:

$$\frac{x - a\cos\mu}{-a\sin\mu} = \frac{y - a\sin\mu}{a\cos\mu} = \frac{z - \frac{l}{2\pi}\mu}{\frac{l}{2\pi}} \qquad (12)$$

It will be noted that if we solve Equations (12) we get Equations (3) and (4) precisely, which shows that (a) *All generators are tangent to the base helix.* (b) *A straight line rolling on a helix so that it always remains tangent to it will sweep a spiral gear surface.*

3. Considering Equations (5) and (6) and substituting for $z = z_0 =$ constant, we shall get the section of the surface with a plane perpendicular to the axis Z. We will prove that the curve thus obtained is an involute of the base circle. Suppose that $z_0 = 0$. This supposition is perfectly permissible, as by a simple transformation the coordinate system can always be brought into a position where any particular $z_0 =$ constant, becomes zero. Equations (5) and (6) become, then:

$$x = a(\cos\mu + \mu\sin\mu)$$
$$y = a(\sin\mu - \mu\cos\mu) \qquad (13)$$

which are the well-known equations of an involute having a for its base radius. Thus we prove the theorem:

Any section of the involute spiral tooth surface with a plane perpendicular to the axis of the gear is an involute of a circle. The same law can also be expressed thus: A correct spiral tooth surface can be swept by a plane involute curve which is rotated uniformly about its axis while it is translated uniformly along the same axis. Or, again, a correct involute spiral gear can be obtained by uniformly twisting an involute spur gear.

It is of interest to know the properties of the so-called meridian curve obtained by intersecting the spiral surface with a plane which passes through the axis Z. The practical importance of this intersection lies in the fact that this will be the tooth curve of a theoretically correct hob, having straight gashes. By taking Equations (3) and (4) and substituting for $y = 0$, we have:

$$x\sin\mu + \frac{2\pi a}{l} z - a\mu = 0$$
$$x\cos\mu - a = 0 \qquad (14)$$

where the value of μ can be calculated from (8)

$$\mu = \frac{2\pi}{l} z \pm \frac{\sqrt{x^2 - a^2}}{a} \qquad (15)$$

It is seen that the curve is a higher transcendental one, and that it has two branches according to the sign in Equation (15) that is taken.

Difficulties also arise in determining the value of a, the radius of the base cylinder. It must evidently be a function of the pitch radius of the hob, the pitch angle, and the pressure angle.

Theory of Pressure Angles

Before proceeding further, it will be necessary to define the pressure angle. While a spiral tooth surface can be defined uniquely from the base helix alone (as we have shown in the previous paragraph), to a practical designer this fact is of little importance, as the base helix of a spiral gear is usually not known. Instead, the pitch diameter, the normal pressure angle, etc., are given, and in order to use our equations we must find the connecting link between the pitch and base cylinders which is the pressure angle. The definition of the pressure angle for a plane involute curve, or a spur gear, is very simple. At any point of the involute, the pressure angle is the angle included by the radius vector, and the tangent to the curve, Fig. 2. Thus at every point of the curve, or, say, for every particular length of the radius vector, there is a certain pressure angle, which can be computed from the following relation:

$$\cos\phi = \frac{a}{\alpha} \qquad (16)$$

where $\phi =$ pressure angle;
$\alpha =$ radius vector;
$a =$ base radius.

It can be seen that for $\alpha = a$, that is, for the point of the involute lying on the base circle, the pressure angle equals

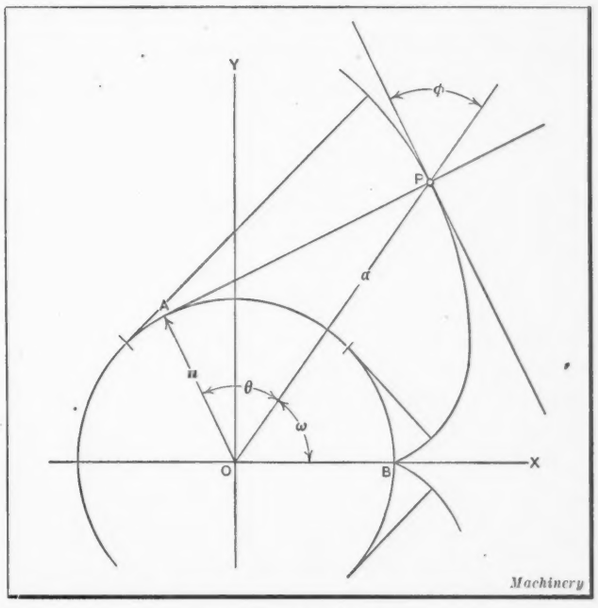


Fig. 2. Plane Involute Curve

zero, and that, by increasing the value of α (a is a constant), the pressure angle increases steadily. What is called in practice the "pressure angle" is the value of ϕ on the pitch line.

We know that for spur gears the same involute curve may work under different pressure angles by varying the center distance of the mating gear. Similar conditions obtain for two spiral gears, as they will mesh under varying center distances, provided the shaft angle is adjusted accordingly.

Pressure Angle

The normal pressure angle of spiral gears at any point of the surface may be defined in an analogical manner to that of a plane involute curve. The pressure angle at any point is the angle included by the radius vector and the tangent plane. The radius vector is the shortest distance of the point from the axis of the gear. This definition of the normal pressure angle is fully in accord with the fact that two spiral gears will not mesh correctly unless they have the same pressure angles. For, imagine that the surfaces touch each other exactly at the pitch point (the point at which the two pitch cylinders touch each other), then the following conditions are satisfied: (a) the tangent planes coincide; (b) the radii vectors coincide, because the pitch point necessarily lies on the line of shortest distance between the two skew axes. Therefore, the normal pressure angles must be equal.

For any point x_0, y_0, z_0 on the surface, the value of μ can be computed from Equation (8), and, by substituting that particular μ, say μ_0, in (4), we have the equation of the tangent plane to the surface at the point x_0, y_0, z_0, thus:

$$x \sin \mu_0 - y \cos \mu_0 + \frac{2\pi a}{l} z - a \mu_0 = 0 \qquad (17)$$

The equations of the radius vector to x_0, y_0, z_0 are:

$$\frac{x - x_0}{x_0} = \frac{y - y_0}{y_0} = \frac{z - z_0}{0} \qquad (18)$$

The normal pressure angle is the angle included between the plane and the radius vector, and it can be calculated from the formula:

$$\sin \Sigma = \frac{Al + Bm + Cn}{\sqrt{A^2 + B^2 + C^2}\ \sqrt{l^2 + m^2 + n^2}}$$

where the equation of the plane is written in the form

$$A x + B y + C z + D = 0$$

and that of the straight line

$$\frac{x - x_0}{l} = \frac{y - y_0}{m} = \frac{z - z_0}{n}$$

Applying the formula to our case, we have:

$$\sin \Sigma = \frac{x_0 \sin \mu_0 - y_0 \cos \mu_0}{\sqrt{(x_0^2 + y_0^2)\left[1 + \left(\frac{2\pi a}{l}\right)^2\right]}} \qquad (19)$$

where Σ is the normal pressure angle of the gear or hob.

Now, let $x_0^2 + y_0^2 = a^2$, where a is the radius vector. It follows from (17) that

$$x_0 \sin \mu_0 - y_0 \cos \mu_0 = a \mu_0 - \frac{2\pi a}{l} z$$

and from (15)

$$\mu_0 = \frac{2\pi}{l} z_0 \pm \frac{\sqrt{a^2 - a^2}}{a}$$

Furthermore,

$$\frac{2\pi a}{l} = \frac{1}{\tan \gamma} \qquad \text{from (1)}$$

Equation (19) becomes then,

$$\sin \Sigma = \pm \frac{\sqrt{a^2 - a^2}}{a\sqrt{1 + \left(\frac{2\pi a}{l}\right)^2}} = \sin \phi \sin \gamma \qquad (20)$$

where γ is the thread angle of the base helix, and ϕ is the transverse pressure angle; that is, the pressure angle in the plane perpendicular to the axis Z.

It will be noted from (20) that, for a given base radius a, the normal pressure angle depends solely on a, that is, the distance of the point from the axis. All points lying on the gear surface at equal distances from the axis have equal pressure angles. By connecting the points of the surface which have equal pressure angles, we get a helix. The normal pressure angle cannot be greater than the transverse pressure angle. On spur gears the two angles become identical.

In order to introduce the pitch radius of the hob, or the gear, into Formula (20), we first write:

$$\tan \beta = \frac{l}{2\pi r} = \frac{a}{r} \frac{l}{2\pi a} = \frac{a}{r} \tan \gamma \qquad (21)$$

where r is the pitch radius of hob, and β is the thread angle of hob on the pitch line. By combining (20) and (21), we may write:

$$\sin \gamma = \cos \beta \sqrt{\sin^2 \Sigma + \tan^2 \beta} \qquad (22)$$

and

$$a = \frac{r \tan \beta \cos \Sigma}{\sqrt{\sin^2 \Sigma + \tan^2 \beta}} \qquad (23)$$

Equations (22) and (23) are very important in the study of spiral gears, as they give the angle and the radius of the base helix in the terms of the pitch radius r, the normal pressure angle Σ, and the pitch helix angle β, all quantities usually known, or easily found.

Correct Tooth Curve of Straight-gashed Hobs

From Equations (14) and (15), we have:

$$x \cos\left(\frac{2\pi}{l} z \pm \frac{\sqrt{x^2 - a^2}}{a}\right) = a \qquad (24)$$

which is the equation of the axial section of the correct hob.

Solving (24) for z, we have:

$$z = \frac{l}{2\pi}\left(\text{arc cos}\, \frac{a}{x} \pm \frac{\sqrt{x^2 - a^2}}{a}\right) \qquad (25)$$

As the equation even in this last form is difficult to plot, we shall introduce a new variable θ such that

$$\cos \theta = \frac{a}{x}$$

Then,

$$\tan \theta = \frac{\sqrt{x^2 - a^2}}{a},$$

and

$$z = \pm \frac{l}{2\pi} (\tan \theta - \theta) \qquad (26)$$

Equation (26) suggests a way to determine the axial section graphically. The right-hand member contains the factor $(\tan \theta - \theta)$, which factor can also be found in the polar equation of the involute curve. The section has, therefore, an affinity with the involute. For, from Fig. 2:

$$\text{arc } AB = \text{line } AP$$

from which

$$a(\theta \pm \omega) = a \tan \theta$$

and

$$\omega = \pm (\tan \theta - \theta) \qquad (27)$$

Now, let

$$\omega = \frac{2\pi z}{l}$$

and Equation (27) is identical with (26).

Graphical Method

Construct an involute, as in Fig. 3, from the base circle, using Formula (23), for calculating the radius a. The coordinate axes X and Z are drawn from the center of the base circle, the axis X passing through the cusp of the involute. In order to find to any given value of x the corresponding value of z, we find the intersection of the involute with the radius vector x, which point connected with the origin gives the angle ω. Now,

$$z = \frac{l}{2\pi} \omega$$

that is, z is the rectified arc of the included angle ω on a circle of $\frac{l}{2\pi}$ radius.

By continuing this process for as many points as desired, the whole tooth curve may be correctly plotted. In Fig. 3, a 1-inch circular pitch, double-threaded worm hob, 3-inch pitch diameter, is shown, and it may be noticed that, by substituting a straight line for the theoretical curve, an error of about 0.006 inch at the tops of the teeth would result, which is quite considerable.

The graphical method for determining the theoretical curve, while interesting, is neither sufficiently rapid nor accurate for practical requirements, due to the necessity of twice rectifying arcs. The mathematical way is more satisfactory, as a rule. Use the following equations:

$$x = a \sec \theta$$
$$z = \frac{l}{2\pi}(\tan \theta - \theta) \qquad (28)$$

and, with a table of sines and a table of radians, the calculation is quite simple.

It will be noted that throughout the article we have carried the double plus-and-minus signs, which gives at least two solutions for each equation. This is due to the fact that the rack-plane actually generates not one, but two, distinct surfaces as it performs its helical motion. Evidently, then, the two surfaces represent the opposite sides of a spiral tooth. For the axial section, the two curves obtained by employing both signs are symmetrical to the X axis, as it can be seen from the Equations (28), which give a symmetrical curve, if $-\theta$ be substituted for θ.

The normal section of the correct hob can be found by intersecting the involute surface with a plane perpendicular to the pitch helix. The normal section will, of course, differ from the axial. In practice, it is more important to know the normal section than the axial, as the hobs having greater thread angles than about 5 degrees are usually spiral-gashed, and it is for the greater angles that the correction is mostly needed.

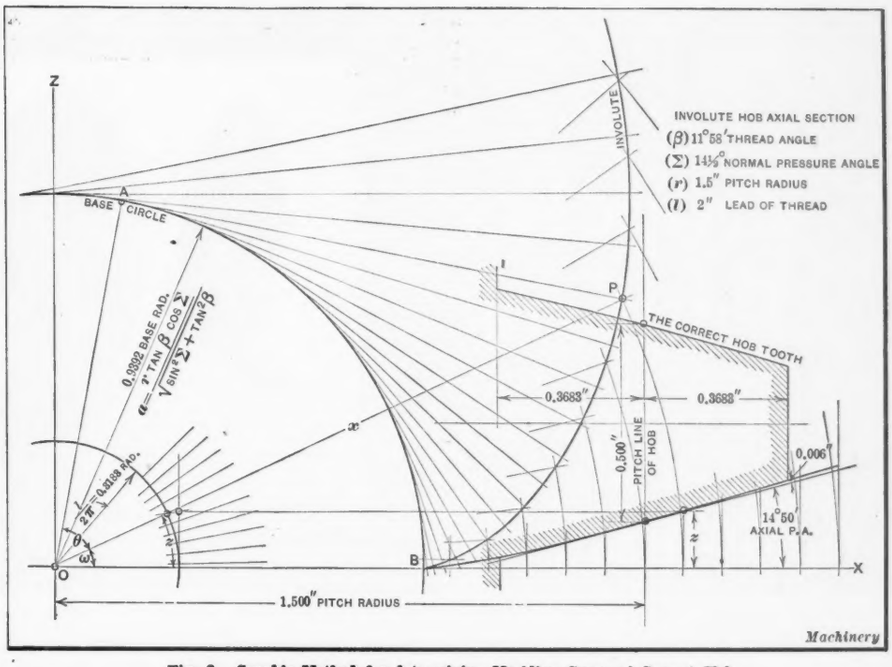


Fig. 3. Graphic Method for determining Meridian Curve of Correct Hob

Hob versus Spiral Gear

The following results can be gathered from the present research:

1. The correct involute hob and the correct spiral gear are essentially the same. A correct hob may be obtained by providing a correct spiral gear with cutting edges.

2. The contact surface of an involute spiral gear can be generated in the following ways:

(a) by a plane, moving helically about the axis of gear.
(b) by a straight line rolling on a helix.
(c) by an involute curve lying in a plane perpendicular to the axis, and moving helically about the axis.
(d) by using the curve obtained from Equations (28) as a meridian curve of the gear.
(e) by an epicyclic-helical motion of another spur or a spiral gear.

The present investigation may also be used as a foundation for the study of the more difficult forms of spiral gearing such as the worm and Hindley worm gearing, particularly for studying the extent and nature of contact. Because, in the light of present theory, the generation of an involute worm-gear is actually more easily accomplished than that of a spiral gear. Applied to worm-gearing, the last clause of the previous paragraph would read: An involute worm-gear can be generated by an epicyclic motion of an involute spiral gear, when the axes are perpendicular to each other.

* * *

The first step toward the extensive use of army trucks for mail service, driven by discharged enlisted men was taken recently by the Post Office Department when it requested the War Department to release seven trucks and four men for a 115-mile star route between Helper, and Vernal, Utah. It is estimated that the cost of operating this route by the use of army trucks will be reduced to about one half. Plans are already made for an interlacing motor truck system with post office terminals extending from the Atlantic to the Pacific coast in the form of a U-shaped route with the three main points at Portland, Me., New Orleans, and Portland, Ore.

MOUNTING TRACINGS ON CLOTH

BY MARK MEREDITH

Tracings supplied to engineers and others should be mounted on some untearable material before they are sent to the works, where they are likely to receive rough usage. Calico cloth suitable for this purpose can be bought in 30-inch widths, and a simple method of mounting the tracings is as follows: Stretch the piece of white calico about two inches wider than the tracing that is to be mounted, by tacking the cloth tightly on a board, allowing about three inches between the tacks. Then sponge well with water to draw out any creases that may be in the cloth. Place the tracing face side down on a clean board, and dampen it well by first passing a moist clean sponge or wide brush around the edges to a depth of about two inches, and afterward, thoroughly dampening the entire surface, except the edges. It is necessary to observe that the edges of the paper shall not be quite as damp as the other part.

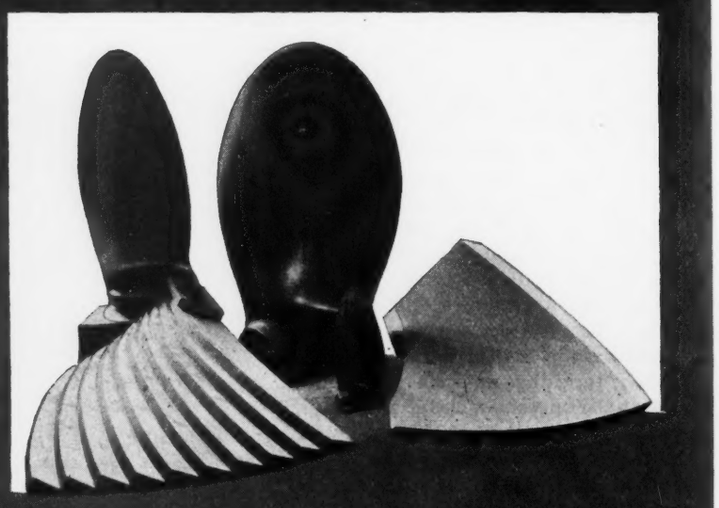
Then take some dextrine paste, which is not too thick and does not contain lumps or foreign substances, so that an even surface may be obtained during the pasting operation. Carefully apply the paste to the surface of the calico with a brush; then with the help of an assistant lay one side of the tracing down for a width of about six inches. The tracing should be held by the assistant above the surface of the calico, at an angle of about 45 degrees, while an area of the tracing about six inches wide is pressed down at a time, by placing the palms of the hands in the middle of the paper, and gently smoothing toward each edge, until it is laid down. Take several large sheets of strong blotting paper, and rub the tracing gently and evenly over the whole surface. The blotting paper should be held firmly with one hand and rubbed with the other. After rubbing, it will probably be found that the tracing has blistered in places, owing to the compressed air underneath the surface. These blisters should be pricked with a fine needle, and the cloth rubbed down as before. The blotting paper should be laid over the whole surface and should be weighted down, and left for several hours to dry.

* * *

The Canadian Government has authorized the War Trade Board to take complete control of all lands, mines, and properties in Canada producing chrome ore. This control is to extend over a period of five years and includes control over all machinery, fuel, power and equipment pertaining to such production.

Propeller Patterns

By Joseph A. Shelly



Second of a Series of Articles Describing the Methods of Laying out Propeller Patterns, Assembling the Different Sections and Working the Blades to the Required Form

A screw propeller for driving a boat consists of a central hub and two, three, or four blades. These blades are sectors of a screw thread and may be cast solid with the hub or made as separate pieces that are bolted to the hub. Large propellers are made in the latter way. The side of the blade that strikes the water first when in action is called the face or working side. It is flat or straight along a cross-section while the opposite side, called the back, is rounding, being thickest in the center and running in an arc to an almost feather edge at the edges of the blade. The blade also tapers from the hub to the tip, being made quite thick at the hub section and rounded to a thin edge at the tip of the blade.

Right- and Left-hand Propellers

A right-hand propeller wheel is one that drives a boat forward when it turns to the right, or in the same direction as the hands of a clock, while a left-hand propeller turns in the opposite direction when driving a boat ahead, the progress of the boat in both cases being viewed from astern.

Pitch of Propeller Wheels

The pitch of a propeller is the distance it would move forward in one revolution if it were a screw acting in a nut, but water is yielding and this causes some lost motion and a difference between the theoretical distance the screw should advance in a given number of revolutions and the distance it actually drives the boat. This is called the "slip" or "slippage" and the per cent of slip is calculated by dividing the slippage by the theoretical distance the screw should travel. The pitch ratio, sometimes referred to, is the ratio that the pitch bears to the diameter of the wheel, and is found by dividing the pitch by the diameter of the wheel. If the blades are sectors of a true screw, the wheel is called a true pitch wheel, while if the blade increases or decreases in pitch from hub to blade tip, it is called an expanding or decreasing pitch wheel, as the case may be. A wheel might be a combination of true, expanding, and decreasing pitch at different points, in which case it would be designated as compound pitch.

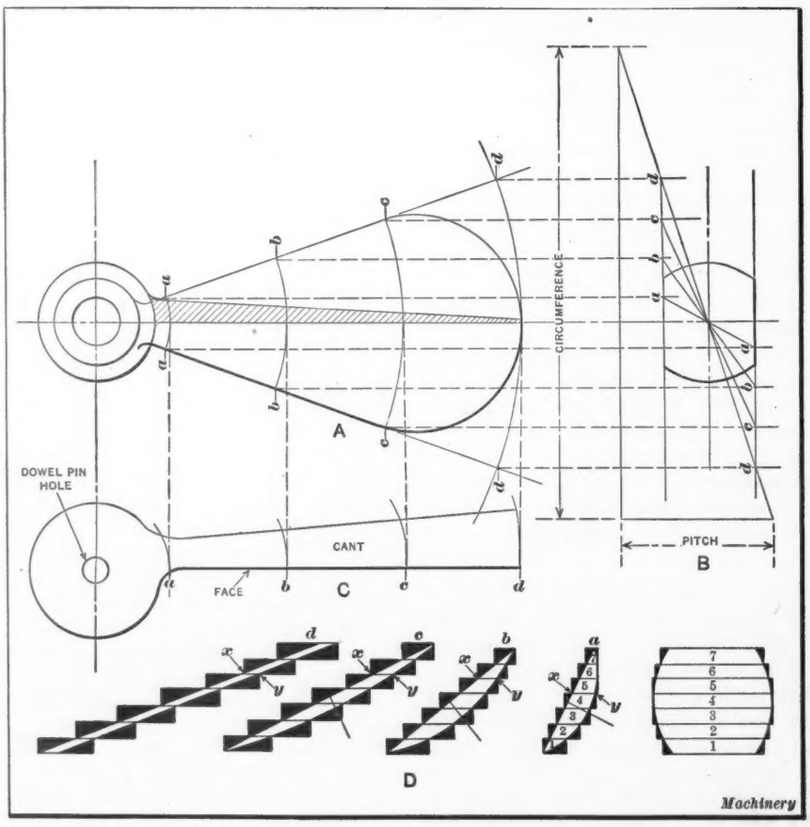


Fig. 1. Diagrams illustrating Method of constructing Screw Propeller Patterns

Pitch Angle of Screw

The pitch angle of a screw is found by laying off on a base line a distance equal to the circumference of the screw and on a perpendicular line a distance equal to the pitch of the screw. By completing the triangle, the hypotenuse gives the pitch angle of the screw. In the case of a propeller it is the

pitch angle at the blade tip. With a propeller this would often mean a very large triangle, so it is customary to divide the diameter and pitch by some number that will give the same proportions on a more convenient scale; a better plan, however, is to use the radius as the base-line distance and divide the pitch by 6.28. The constant 6.28 is the quotient obtained by dividing the circumference of any circle by its radius.

Propeller Patterns

Except in the case of very small wheels it is not customary to make a pattern for more than one blade, as a better balanced casting results from all the blades being molded from the same pattern. The molder can readily move the blade to form a wheel with the desired number of blades. The draftsman usually works out all the details of the wheel to be made, such as the outline of the wheel, the pitch angle, and sections at different points on the wheel radius, but practice in this respect varies greatly and sometimes the information furnished is quite meager and the patternmaker has to work out many of the details for himself on his full-size drawing or lay-out. A true screw is one in which all the face elements are straight lines radiating from the hub center to the pitch angle at the blade tip, and is built of layers or cants of parallel thickness, with the edge that is to coincide with the face of the wheel a perfectly straight radial line. These cants (See sketch *A*, Fig. 1,) are made with the hub section as part of the cant, and to insure the face lines running to the center a hole is bored through the hub center on each cant to fit a dowel-pin. Enough cants must be used to make the entire blade equal in width to the widest part. With some forms of blade it is not necessary to extend all the cants to the center, as some sections will project above or below the hub, although it is the practice in some shops to run them all to the center and cut the hub down to thickness afterward. The thickness of the cant stock will usually vary from ¾ inch to 2 inches depending on the size of the wheel and the stock available. It is essential that the stock be of even thickness and parallel, as if it is not, the wheel will run out of true when it is built.

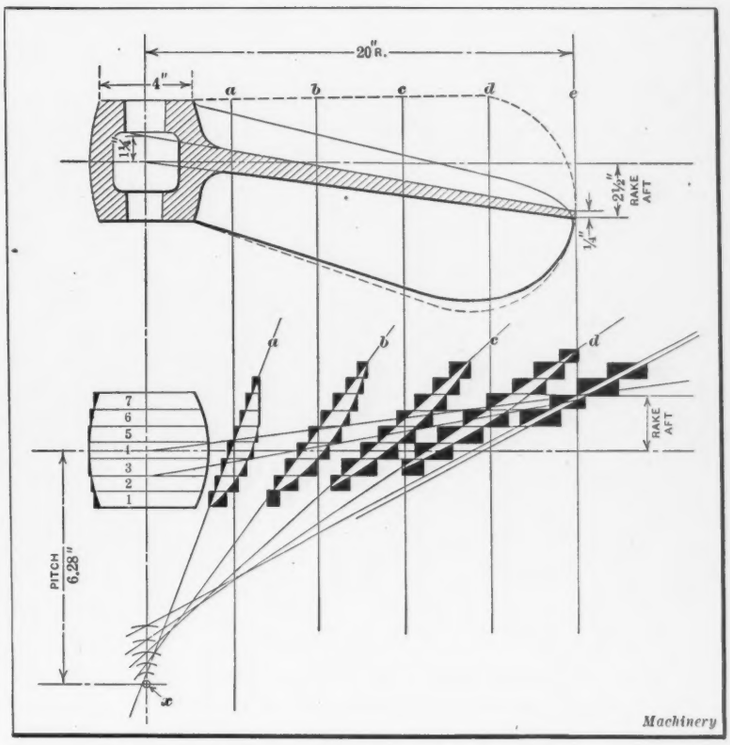


Fig. 3. Patternmaker's Lay-out for Propeller having Rake Aft

Laying out Propeller Wheels

In laying out propeller wheels a smooth board of ample size is required. It should have one straight edge and it is a good plan to sandpaper it to a smooth surface all over. Fig. 1 shows a lay-out for building a wheel, the pitch angle being found by laying off the circumference and pitch. A plan of the wheel with a scale of thicknesses shown in section is illustrated at *A*. The radius of the wheel is divided into an equal number of parts designated *aa; bb; cc;* and *dd*, and the straight edges of the blade are continued out to the periphery *dd* for convenience, as all cants are to extend from the outside to the center. At *B* is shown the hub with the pitch angle *dd*, at the blade tip, intersecting the hub center. By projecting *aa*, *bb*, *cc*, and *dd*, of lay-out *A* over to *B*, the pitch angles at these points are determined. For convenience these pitch angles and the hub lay-out are transferred and arranged as at *D*. The thickness and number of cants is now determined and gaged from the edge of the board and a center line square with the face of the blade is drawn on sections *a*, *b*, and *c*. The thickness in the center of each section is transferred with a pair of dividers from corresponding points on the thickness section on the plan *A*, and arcs are drawn intersecting these points and the edges of the blade. The thickness at the blade tip is shown by a parallel line also taken from the thickness section at *dd* on the plan. Lines are then squared from the points where the pitch angles and the backs of the blade intersect the parallel cant lines as at *x*, *y* and similar points. This gives the widths at the designated positions of all the cants, each of which will be different. At *C* is the lay-out for

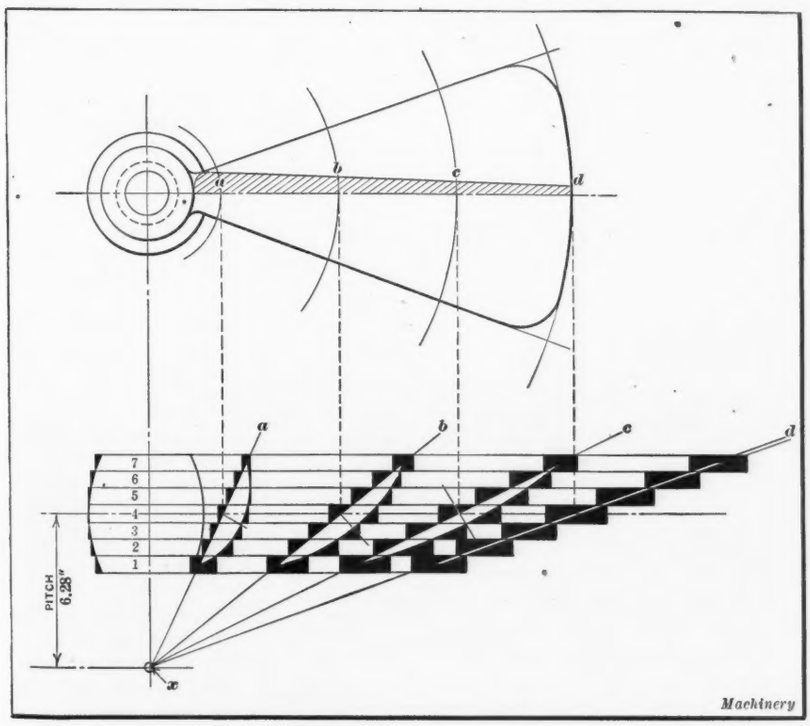


Fig. 2. One Method of laying out Propeller Pattern

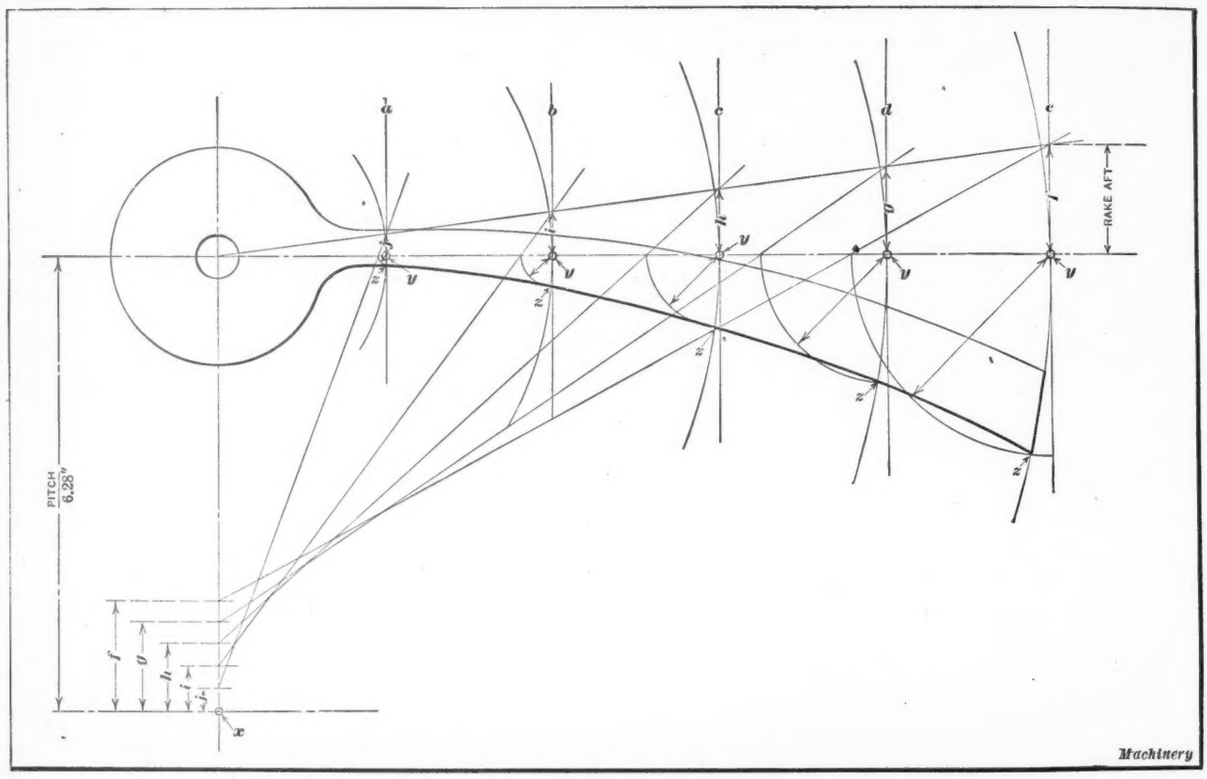


Fig. 4. Method of developing Face Curve for a Rake-aft Type of Propeller Pattern

cant No. 5; it is, of course, laid out directly on the stock by gaging a center line from one edge which should be straight and squaring a cross-line for the hub center. Radii *a*, *b*, *c*, and *d* are then transferred from the plan to the cant, and the thickness and hub diameter are taken from the corresponding sections of cant No. 5 shown at *D*. A fillet is drawn connecting the hub circle with the face edge of the cant and a thin batten is used to draw a line through the points on radii *a*, *b*, *c* and *d;* this will not be a straight line. A hole for a pin is bored through the hub center and then the cant is ready to be band-sawed. The procedure for the other cants is similar to that described. To save time in laying out, a templet may be used to scribe the radii.

When the pitch angle is determined by laying off the radius and the pitch divided by 6.28, the propeller may be laid out as illustrated in Fig. 2. The points *a*, *b*, *c*, and *d* on the plan are projected across to the transverse center line of the hub. The pitch point *x* is laid out on the axial center of the hub a distance below the transverse center equal to the pitch divided by 6.28. By drawing lines from the pitch point *x* through the intersections of projections *a*, *b*, *c*, and *d*, the pitch angles at these points are determined. The rest of the lay-out is the same as in the preceding illustration.

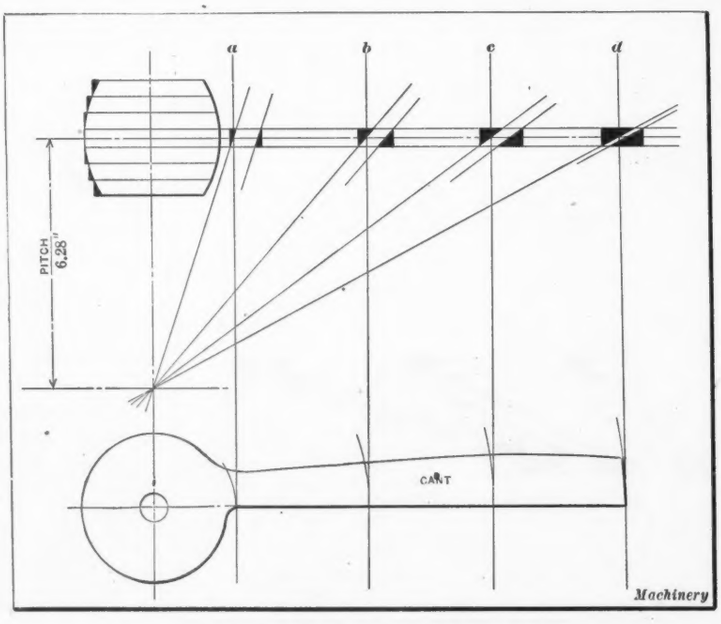


Fig. 5. Lay-out for a True Pitch Propeller

Propellers Having Rake Aft

So far we have only presented lay-outs for true screws, but there is another type of propeller in common use that requires considerably more skill to lay out and build. This is the wheel where the blade is inclined astern or has a "rake aft," as they say. A drawing and lay-out for such a wheel is shown in Fig. 3. On the lay-out the center line of the wheel and the lines representing the face of the wheel, the rake aft, and the thickness of the blade from hub to tip are drawn. The pitch point is the same as for a true screw, but the pitch points for *a*, *b*, *c*, and *d* must rise to suit the rake, and are stepped off above the pitch point to correspond to the distances the face of the wheel is offset relative to the horizontal center at *a*, *b*, *c*, and *d*. The sections are laid out in the same manner as for a true screw, but the lay-out and appearance of the cant will be different; instead of a straight face it will be curved.

By referring to Fig. 4 it will be noted that the pitch points for *a*, *b*, *c*, and *d* have been laid off above pitch point *x* and the pitch angles are drawn from these points through the intersections of *a*, *b*, *c*, and *d* with the face or rake aft line. To develop the face curve, arcs are struck from points *y* on the horizontal center line. These arcs intersect the points where the pitch angles intersect with the horizontal center lines. The face curve is then drawn through the points *z*. The widths are then taken from the lay-out, and a curve is drawn for the back of the cant. The wheels so far illustrated were laid out with a view to forming the backs by cutting away the surplus

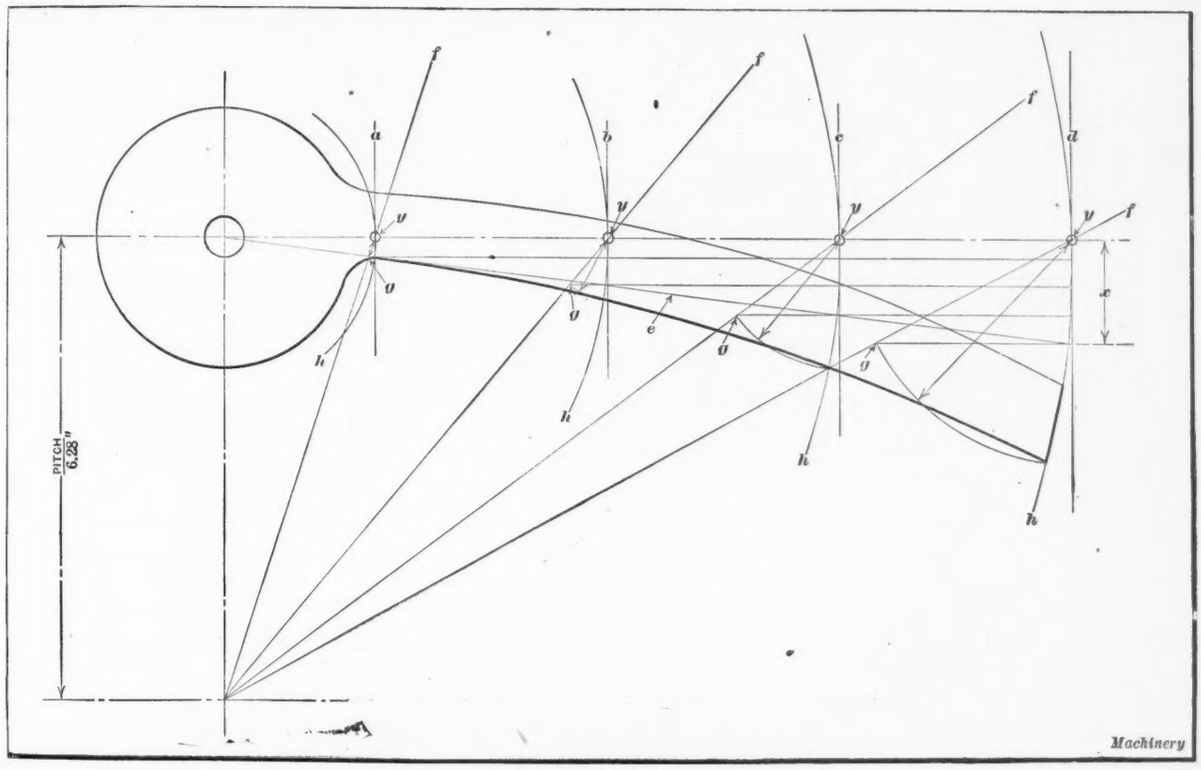


Fig. 6. Another Form of Lay-out for Propeller Pattern

material between the intersections of the glue joints as indicated by the darkened portions of the sections. This method gives a finished wheel, but is only applicable to comparatively small wheels—say 4 or 5 feet in diameter. The more common method is to make all the cants alike and work the backs off to thickness afterward.

The lay-out for a true pitch wheel where all the cants are alike is shown in Fig. 5 and should require but little explanation. A single cant thickness is shown and lines parallel to the pitch angles representing the thicknesses of the blade at these points, are drawn; this gives the width of the cants at these points and has only to be transferred to the cant stock itself. If the blade is to have a rake aft, the same lay-out will do, but the cant will have to be laid out differently. In the lay-out shown in Fig. 6, the pitch angles all extend from a common point intersecting the center line of the cant at points *y*. Next a point is laid off on the vertical line *d*, a distance *x* below the horizontal center line, equal to the rake aft. A diagonal line is now drawn from this point to the center of the hub. Horizontal lines are then drawn through the points where the diagonal line *e* intersects the vertical lines, *a*, *b*, *c*, and *d*. These horizontal lines are extended to intersect the pitch angle lines *f* at points *g*. With points *y* as centers and with radii *yg*, arcs are drawn which intersect arcs *h*. The face curve is then drawn through the latter intersecting points.

Where the cants are the same, a number may be bandsawed at once by bradding them together. All the cants required for a small wheel should be sawed in this way with a pin through the holes in the hub. Before they are taken apart, a line indicating the face lap should be gaged from the face edge of the cant on the ends as a guide to gluing. The size of the hole to bore through the hub center will depend largely upon the size of the wheel. On large wheels the hole should be big enough to accommodate the molding spindle, but on small wheels a dowel-pin may be used and the hole for the molding spindle bored after the wheel is finished, but it is essential that the pin be straight and not fit the hole too tightly.

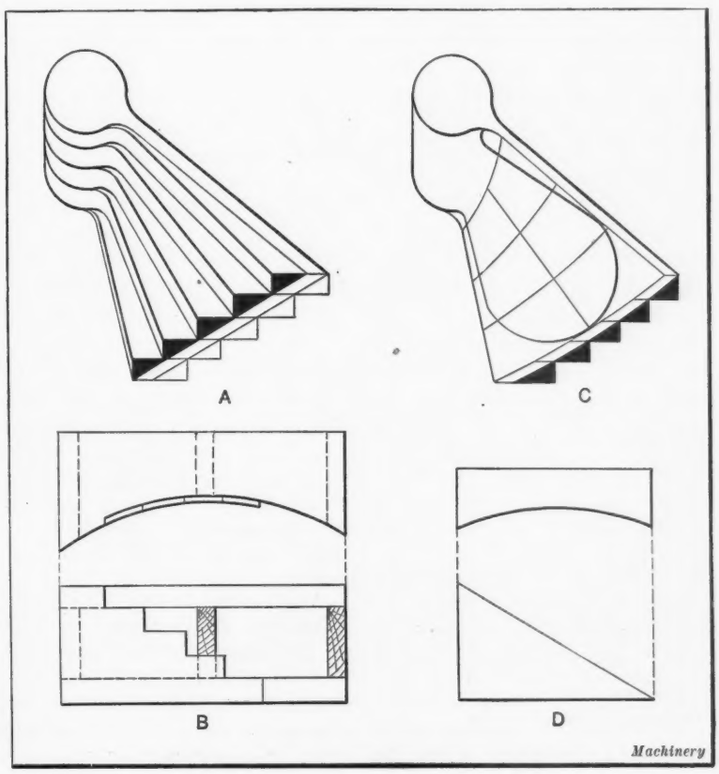


Fig. 7. Building up Propeller Patterns

Gluing Propeller Cants

Small propeller wheels with all the cants alike may be glued up by setting each cant to the gage line on the end and using hand screws to clamp the whole together. A thin brad should be toed through the end of each cant into the one beneath to prevent them from slipping. Such a wheel when glued will appear as shown at *A*, Fig. 7. For larger wheels a gluing up board will be

required. The surface of this board should be perfectly true, as it is used to check the accuracy of the pattern. The face of all cants should be parallel to this board. A hole is bored in the board to accommodate the hub pin and the first cant is placed in position and fastened to the board either by means of nails or screws, the successive cants being glued and nailed or screwed in place. Screws are most convenient, but many prefer nails, removing them before starting to work the face off. It is sometimes advantageous to use hand screws instead of nails or screws, but it is a slower process, as the glue must set on one course before another can be applied.

There has always been more or less discussion among patternmakers as to whether the back or face side of the blade should be upward in the building, but as the face is the side that is to be worked off first we will assume that it is the most convenient side to have facing up on the building board. The lap at the tips of the cants is usually made by setting to a gage line or by measurement although some workmen brad a small thin block on the face of the cant for the next one to abut against and secure uniformity in this way. When the cants do not run all the way to the tip or hub, the lap will have to be laid off on the face of each cant at the section radii.

When all the cants are the same, the lap is sometimes secured by using the device shown at *B*, Fig. 7. This is a block cut to fit the outside of the wheel and having a thin piece of wood bent to conform to the curve and nailed to it; this thin piece of stock is cut to fit the under side of the cants and when fastened to the building board in the proper position, goes under the cants and gives the necessary lap without measuring or gaging and prevents the wheel from sagging if it is large. Another device for preventing the wheel from sagging in the building is the angle-block *D*. This is made to slip under the edges of the cants which must be worked off for about a half inch to accommodate it. The block holds the cants in place while building, but is not an aid in setting them. If the cants are to be built against a turned hub they will have to be cut to fit the hub and it may be necessary to support them both at the point where they fit the hub as well as at the tip.

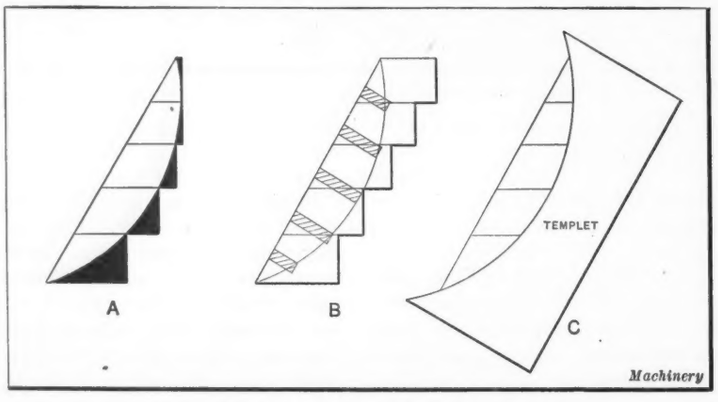


Fig. 8. Methods of forming Back of Propeller Blades

Forming the Face of the Blade

When the glue has dried and all nails or screws are out of sight, the face of the wheel should be worked off with a flat bent-tanged inside-ground gouge, which should be held at such an angle that it will cut a straight line from the intersection of one glue joint to the intersection of the next. Spoke-shaves should be used to finish with, and it is advisable to have several of different sizes with the faces rounded to reach all parts of the surface. If the wheel is very large an adz judiciously used is helpful in roughing off the face. The wheel should be clamped at the hub to the bench or held in a hand screw clamped in the vise, while the face is being finished. That part of the hub which joins the face should also be finished at this stage of the work. When all the tool work is finished the face should be sandpapered and given a coat of varnish. If the blade is very wide a batten should be screwed to it to hold it straight.

Laying out and Working the Blade Outline

In laying out the blade outline a center line should be drawn across the face of the blade and radii laid off to correspond to the section radii on the lay-out. The widths of the blade should be marked off on the radii and the outline drawn through these points. In measuring the widths of the blade at different points on the pitch angle lay-out, it must be remembered that the measuring is done in a straight line whereas on the wheel face the line is an arc of a circle. A corresponding circle should be drawn on each section of the lay-out and the distance stepped off in half-inch dimensions for transferring to the blade face. The wheel will now have the appearance shown at *C*, Fig. 7. The blade is next worked to outline, keeping the edges square with the face.

Working the Back of the Blade

There are three methods of insuring the proper thickness and section on the back of propeller blades. The first is to build the blade with the cants cut to conform to the varying thicknesses, in which case it is only necessary to work the back from one glue joint intersection to the next in an arc as indicated by the dark portions at *A*, Fig. 8. The second method, which is used on very large wheels, is to bore a series of ¼-inch holes at each section arc and drive pins into the proper depth to give the correct section when the blade is worked off to the pins as at *B*. The third method, which is commonly used, is to work the back to a templet, (as at *C*) at each section, using a rather sharp bend inside gouge for cutting the groove for the templet. After the templets are fitted to the different sections, the intervening stock is cut away and spoke-shaved to merge smoothly into them. Except near the hub, the edges of the blade are not a feather edge formed by the arc of the back but are gaged to thickness and rounded or "sharpened" to a feather edge after the backs are finished. If the hubs have been built up to form, the procedure in finishing them is apparent, but if the hubs of the cants have been made alike they will have to be worked barrel shaped to a templet.

Propellers Made with Cores

Small propeller wheels are frequently made in cores by placing the blade pattern on a follow board in a core-box with the back up. The box must include as much of the circle as there are to be blades in the wheel and the bottom to which the follow board is fastened should be loose, as it must be lifted away to ram up the face of the blade. The core is made in two pieces and pasted together after it has dried.

Aerial Propellers

The principles employed in laying out and building marine propellers are applicable to those used on the airplane. A built-up or canted airplane propeller may be laid out in the same way except that two blades will be required and the wheel will have to be placed on a shaft and worked to a standing balance.

* * *

A Glasgow shipyard has recently completed the British twin-screw Diesel engine vessel, *Glenapp*, which is said to be the largest and most powerful motor vessel in the world. It is of 10,000 tons dead weight and has two sets of engines, giving a total horsepower of 6600. The engine room auxiliaries, as well as all deck machinery including the steering gear, are electrically driven, the power being generated by two auxiliary Diesel sets in the engine room.

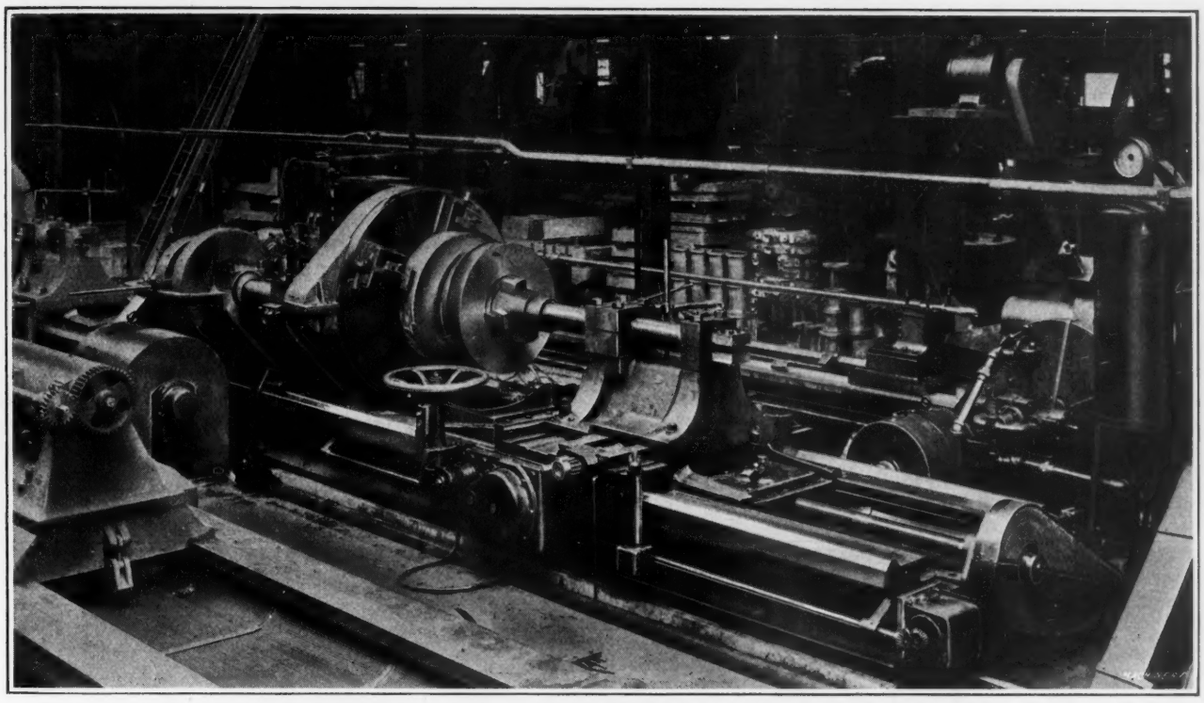


Fig. 1. Lathe designed by the Allis-Chalmers Mfg. Co., for boring Turbine Spindles

LARGE LATHES FOR MACHINING TURBINE SPINDLES

BY A. M. M.

FEW people realize the great amount of preliminary work required before starting actual construction on any large contract for special machinery. Nearly all machinery ordered by the Government for any purpose is special machinery; therefore, the immense orders now being placed by the Government for engines and machine equipment for ships under construction call for a great amount of special preparation before the work can be started.

Although the war has been brought to an end, our shipbuilding program will be continued with as much energy as ever, for the great loss in ship tonnage will make it necessary to build as many ships as possible. In a recent visit to the plant of the Allis-Chalmers Mfg. Co., at West Allis, Wis., the writer was particularly impressed with the tremendous scale on which the preparatory work is conducted. In preparations for filling one order for marine turbines, preliminary work involving an expenditure of nearly a million dollars and extending over more than a year's time was found necessary.

Example of Special Machinery Required

The lathe shown in the illustration Fig. 1 may be cited as an example of the special machinery required for quantitative production of special parts for large machines. This lathe is one of a battery of six designed and built by the

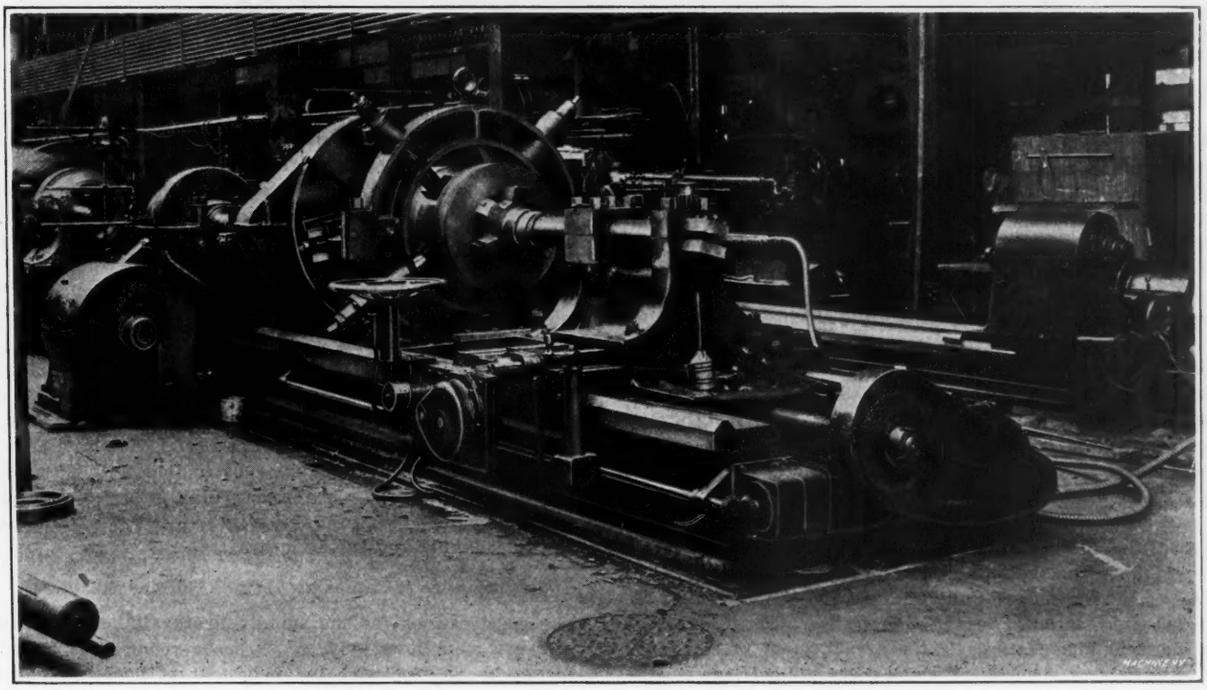


Fig. 2. Lathe equipped with Steadyrest employed when using Large Boring-bar

Allis-Chalmers Mfg. Co., to rough-turn and bore out the heavy steel castings of which turbine spindles are composed. These spindles are made up of several pieces, one of which may be seen undergoing machining operations in the lathes shown in Figs. 1, 2, and 3. Before these lathes were built, this work was performed in a heavy lathe of the usual type, but when the new lathes were put into operation it was found that they did the work at a greatly reduced cost. However, the corresponding saving in time was considered to be of greater importance than the saving in money. Several of the lathes are fitted and equipped for boring out the large chamber in the ends of the steel castings. In this operation, solid material is bored out to form a chamber about 20 inches in diameter by 30 inches deep. The other lathes are fitted with a carriage designed for rough-turning the outside of the castings where there is also a large amount of metal to be removed.

Figs. 1 and 2 show one of the lathes fitted for boring the turbine spindles. The carriage is designed to occupy the position of the ordinary tailstock and is intended to carry a heavy boring-bar. The piece to be bored is held in a chuck and guided by the steadyrest as shown in Fig. 2. The boring is completed in four operations. The first bar used terminates in a hog-nosed drill, which bores a hole 6 inches in diameter to the required depth. This bar is then exchanged for another carrying a four-cutter boring head which enlarges the bore to a diameter of 12 inches. This head is later replaced by a six-cutter head as shown in Fig. 2, which enlarges the chamber to 19½ inches in diameter. After this operation is completed, a bar carrying a single-point boring tool is used and a light cut is taken to bring the chamber to be desired rough-finished diameter. The interesting features of this lathe include its unusually strong and rugged construction and the special conveniences provided which enable the various operations to be performed with speed and accuracy. The boring-bar is mounted in such a way that a heavy cut may be taken without overloading any part of the machine. A large stream of cooling liquid keeps the cutting tools well covered.

All of the various motions of the lathe are controlled by the operator stationed at the side of the carriage. One of the most notable features is the arrangement of the rapid traverse driving mechanism which gives the carriage a wide variation of speed under the control of one lever. The main drive of the carriage is through a central feed-screw which is provided with an Acme thread 3½ inches in diameter, having 4 threads per inch. This feed-screw is connected through the medium of an automatic electric clutch with gearing from the headstock spindle. When the clutch is engaged, the screw and carriage are driven at the normal boring speed. The tail end of the feed-screw is connected to the variable-speed motor *B*, Fig. 4, mounted at the end of the lathe bed. This motor is reversible and has a speed variation of from 1 to 4. It is wired in series with the electric clutch which connects the feed-screw with the spindle drive gear.

When power is applied to this motor, the feed-screw is automatically disengaged from the slow-speed drive and is free for high-speed travel in either direction. When the controller handle is returned to the "off" position, the clutch automatically restores the engagement with the slow-speed spindle gear. The carriage may be unlocked from the feed-screw when desired by the usual type of split nut. With this arrangement the operator may, by the manipulation of the one-control handle, operate the carriage through the entire range of speeds, from the slow boring speed to the rapid traverse speed which varies from 15 inches per minute to 5 feet per minute in either direction. The carriage when disengaged from the feed-screw may also be operated by a handwheel. A power-driven cross-feed of the usual type is also provided.

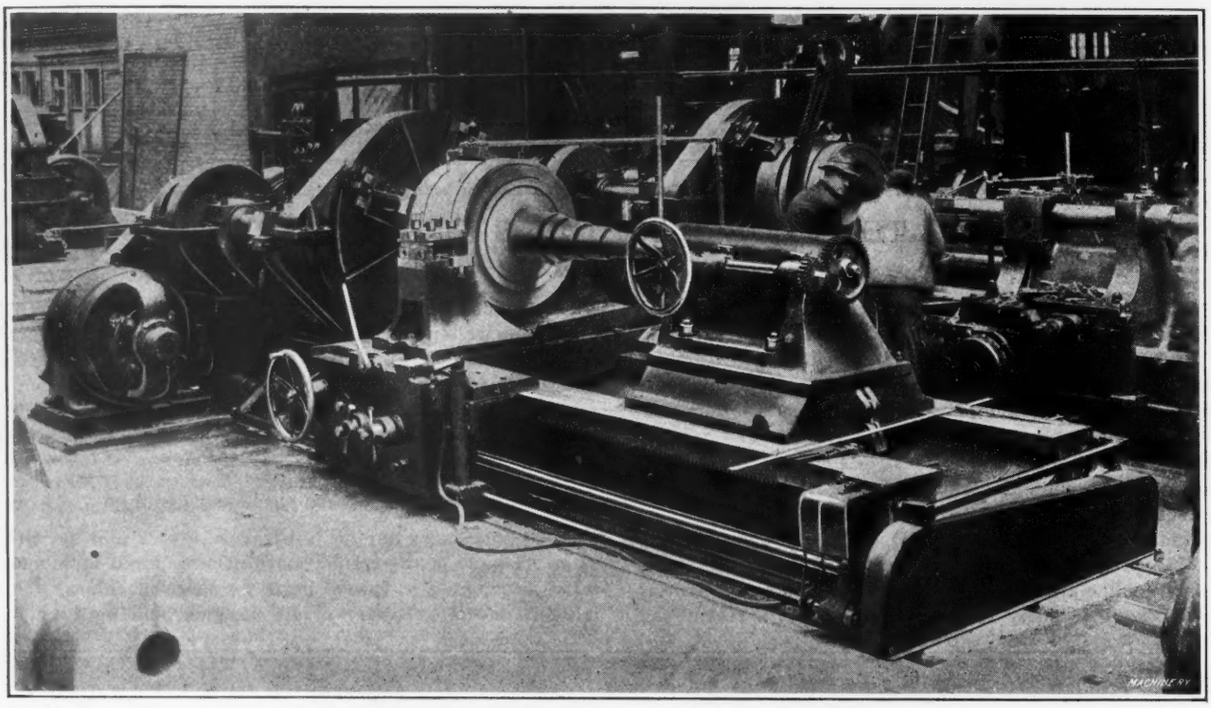


Fig. 3. Turning Lathe designed for rough-turning Turbine Spindles

The stopping and starting of the lathe is controlled by a push-button mounted on the carriage. A dynamic brake on the main-drive motor serves to bring the lathe quickly to rest when the power is shut off. The rough-turning lathe shown in Fig. 3 is fitted up in the same way except that the carriage is driven by a rack on the side of the lathe bed instead of by a central screw, as is the case in the boring lathe. Other variations in construction will be noted from the illustration of the rough-turning lathe. The headstock and spindle construction is practically the same in both the roughing and boring lathes.

Specifications of Lathes for Turning Turbine Spindles

The specifications for the spindle-turning lathe shown in Fig. 3 are as follows: The floor space required is 9 feet 6 inches by 23 feet, and the height from floor to center line of spindle is 48⅝ inches; the height from top of bed to

center of spindle is 27 inches. The spindle bearings consist of babbitt lined cast-iron shells, the front bearing being 17 inches in diameter by 16 inches long and the rear bearing, 10 inches in diameter by 12½ inches long. All of the headstock bearings are oiled by a forced-feed lubricator. Hand and power feeds are provided for cross and transverse movement of the carriage. The spindle speeds vary from 5 to 47 revolutions per minute. The main drive is furnished with a 25-horsepower motor having a variable speed of from 525 to 1575 revolutions per minute. Conveniently located push-buttons control the speed of the motor, and dynamic brakes are provided which make it possible to bring the spindle to a stop very quickly. The motor transmits power through a chain drive in either direction. The driven gear on the spindle has 75 teeth of 1½ pitch and is 7 inches wide. The spindles are made of high-grade cast iron. The total weight of the machine with motors is approximately 60,000 pounds.

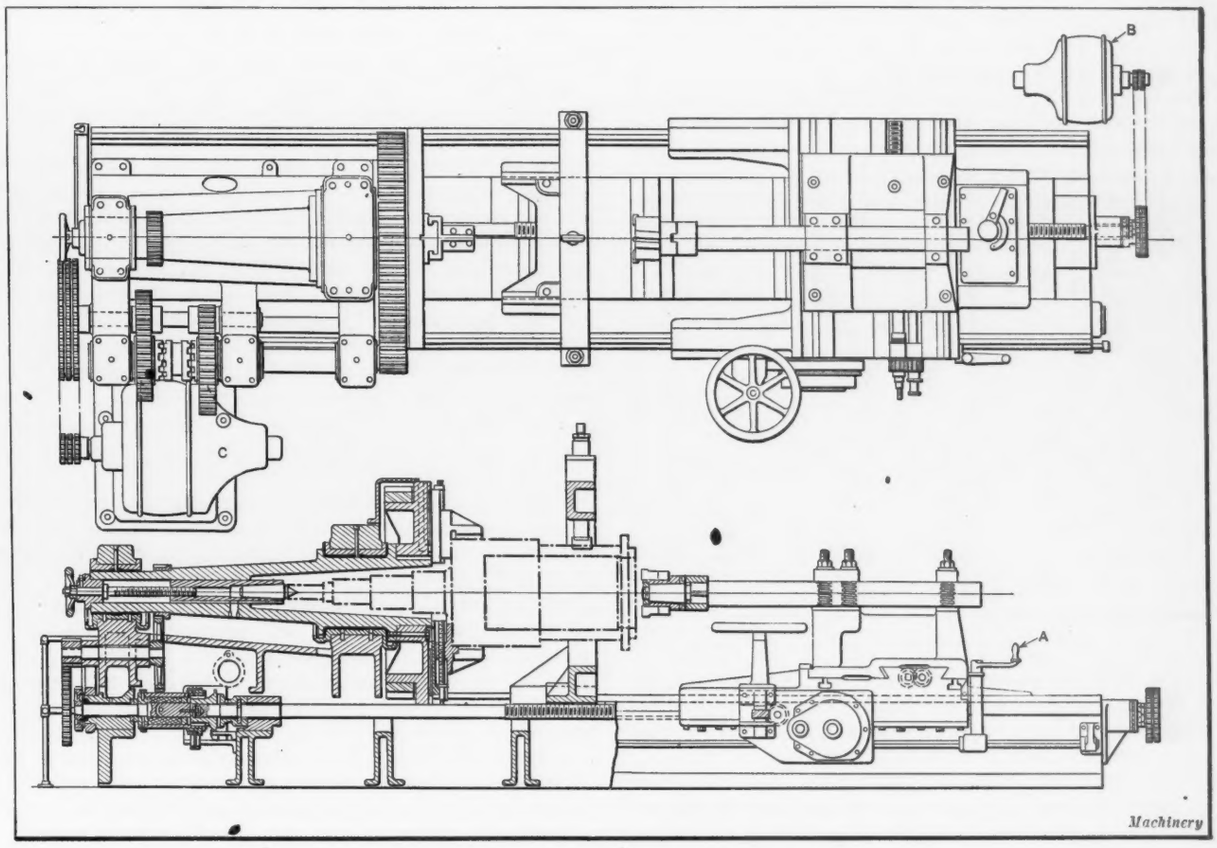


Fig. 4. Assembly View of Boring Lathe shown in Fig. 1

Specifications for the Chamber Boring Lathe for Boring Turbine Spindles

The specifications for the chamber boring lathe shown in Figs. 1 and 2 as before stated are practically the same as are those for the spindle-turning lathe. By referring to the illustrations, it will be seen that the feed-screw of the boring lathe is so located that it transmits motion to the carriage at a point between the V-ways. In Fig. 4 is shown an assembly view of the chamber boring lathe. At *A* is located the quick-traverse control which also controls the magnetically operated clutch. At *B* is shown a 5-horsepower variable-speed motor, which drives the carriage when the rapid traverse mechanism is in action. At *C* is the main drive motor which is of 25 horsepower and has a variable speed of 525 to 1575 revolutions per minute.

Organization for Production of Ship Fittings

In the manufacture of a turbine of this kind, it is necessary to put into motion the productive machinery of dozens of different industries so that their products flowing into the assembling department make it possible to complete and deliver the required number of machines each month, after production has once commenced. Each of the various contributing industries, which may include steel foundries, bronze foundries, pattern shops, valve fitting shops, rolling mills, and many others are obliged to arrange their plans a long time in advance in order that their supplies may be ready and coming in at the right time. Each of the factories or shops has its own experimental work to do before it settles down to producing these parts in quantities as required. In addition to the preliminary work necessary in order that the material may be ready and in the condition required, thousands of men must be trained in the shops to handle quantity production and insure that the machines may be turned out on an economical basis. Many carloads of special tools, jigs, and fittings must be manufactured within a degree of accuracy which uses the one thousandth part of an inch as the standard unit of measurement.

After one has observed all of these converging lines of effort and industry so painstakingly arranged and resulting in a fixed number of perfect finished machines being turned out every month, it seems an industrial crime to upset this organization and to permit the component parts so carefully organized and trained to be scattered and disassociated when the particular order under construction is finished. This state of affairs exists in hundreds of plants throughout the country. One plant may be building a lot of boilers, another may be building duplicate sets of pumps, another, steering engines, windlasses, valves, electrical apparatus of a special design, and innumerable other products necessary in the equipping of ships. Frequently within thirty days after the organization has been broken up, another order is received for practically a duplicate of the same equipment for additional ships.

In this case, another long preliminary period of preparation must be passed through and all of the scattered elements reassembled. It is also the usual custom to make such "slight improvements" in design as will necessitate throwing away all of the jigs and tools prepared for the first lot of machines. The second lot of machines will probably be

so much like the first set that it would be impossible for an expert to tell them apart without making careful measurements; but these invisible changes will have cost the country a great amount of money and delayed production for a considerable period of time.

It is to be hoped that the government departments have now become sufficiently coordinated to anticipate this state of affairs and to avoid it by combining their orders for all of these various machines so that the manufacturing processes may continue without interruption until the requirements have been taken care of for a long time in advance.

* * *

HANDLING DEVICES FOR LARGE SHELLS

BY M. H. POTTER

One of the difficult problems in connection with the machining of the larger shells is that of handling them between operations. A few special devices described and illustrated in this article have been successfully used in handling large shells, and are especially noteworthy as regards simplicity, ease of manipulation, and rapidity.

The tongs which are shown at *A*, Fig. 1, are used to handle finished shells, and when properly made to fit the inside contour of the shell, the threads in the nose of the shell will not be damaged. The two forged shell tongs are riveted together at *c* so that they may open and close freely. The

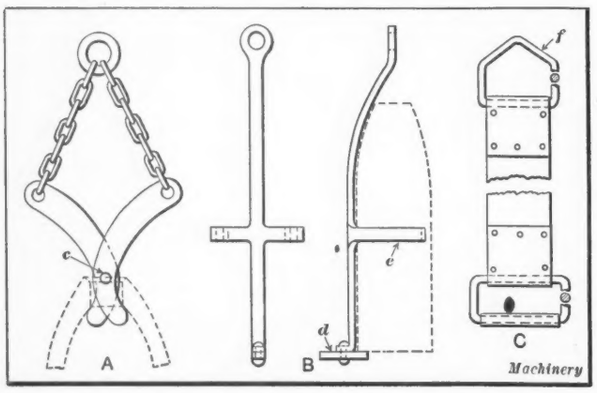


Fig. 1. Tongs, Hook, and Sling for handling Heavy Shells

ends are hung in the ring, as shown, by chains of any suitable length according to requirements. The view at *B* shows a shell hook, the upper end of which contains an eye through which the chain block or hydraulic hoist may be attached. The cross-piece *d* forms the support for the shell at the bottom, and is riveted so that it can be revolved. When the shell is in position, the cross-piece is placed crosswise as shown in the illustration, and together with the arms *e* holds the shell while it is being lifted. A simple and handy sling is shown at *C*. This may be made either from a piece of heavy canvas or from leather belting. A steel eye is riveted to each end of the belt; the smaller one, shown at *f*, is capable of being passed through the larger one, thus forming the sling. There is a roller on the larger eye consisting of a short steel tube, which prevents excessive wear upon the belt when the sling is loaded.

A convenient method of moving shells by hand is shown at *A*, Fig. 2. The handle is made of hard wood having a piece of wrought-iron pipe driven into one end. It is used to facilitate rolling the shells along the floor or bench. The pipe is inserted into the nose of the shell and the handle held by the left hand at about the angle shown in the illustration, while the shell is rolled along by the right hand. For moving shells on the floor, the truck shown at *B* is very convenient. It is simple in operation, the operator forcing the handle downward when wishing to truck the shell, thereby dropping the piece to the position shown in the illustration. Attention is called to the roller at the end of this piece, which prevents the shell from being marred by the

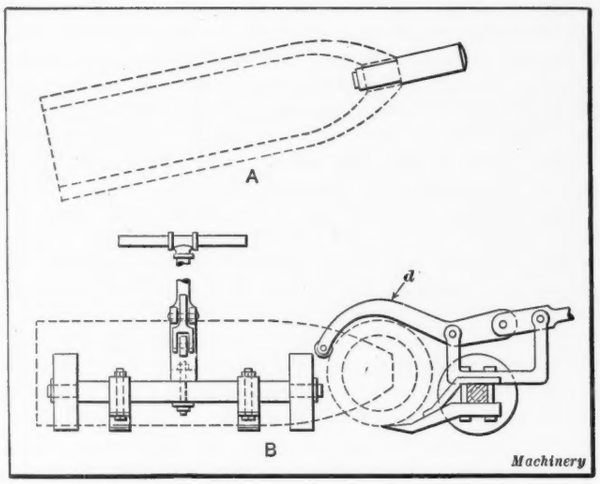


Fig. 2. Devices for handling Heavy Shells

arm *d*. The shells are released by simply raising the handle.

In handling the larger shells, that is, 6 inches or over, it has been practically demonstrated that the bench system is far superior to trucking; in fact, there is no other logical means of handling such shells to advantage. The benches, such as shown in Fig. 3, should be made in sections, and the sections bolted together. Where the bench must extend across the main passageway of the factory, the passageway should be bridged as shown in the illustration. The shells, of course, are rolled along these benches from one operation to another. Where space does not permit the use of a wide bench, one wide enough for a single shell can be used. The height of the benches should correspond with that of the machine centers.

* * *

WOMAN LABOR IN FOUNDRIES

Women in great numbers are now employed in machine shops on regular commercial machining operations, but woman labor has not been employed in foundries, as a general rule, except for such work as making light cores; though in a few foundries, women have also been employed as bench molders. Women will probably continue to be employed largely in machine shops, but it is to be hoped that they will not be employed more extensively in foundries. Foundry work is unsuited to women, and, in many cases, likely to be detrimental to their health. A line should be drawn beyond which the employment of women should not go. So great is the amount of light machine work that must be done in many of our factories that it affords ample opportunity for the employment of all women who seek to do industrial work. It is far better to transfer men from this lighter machine work to foundry work than to train women for labor that is not suitable for them. In this question of woman labor there must be a definite policy, and it would be well for both manufacturers and labor unions to take a definite stand regarding it.

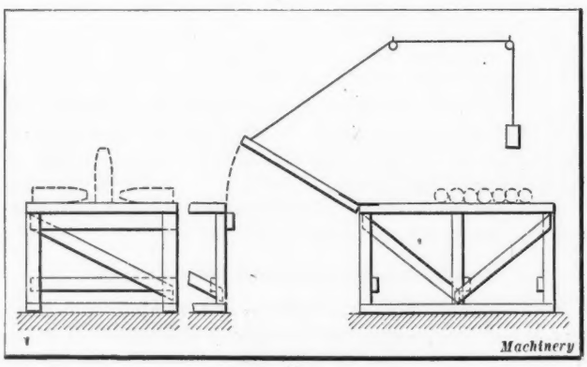


Fig. 3. Shell Bench

Duties of the Employment Manager

BY CHARLES W. MOON

Employment Manager, R. K. Le Blond Machine Tool Co., Cincinnati, Ohio

IT is gratifying to note that, during the last few years, it has become more generally recognized that proper methods of employment management are as important as proper methods in the productive and administrative departments of an industrial undertaking. The leaders in the industrial field have gradually come to see that the employment department is as important as the purchasing department, if not more so. The purchasing department buys materials, the employment department buys labor. In any ordinary manufacturing industry, the amounts involved in purchasing labor are much greater than those involved in purchasing materials; and, furthermore, the difficulties in accurately determining the labor values are much greater than in determining values of materials. In the latter case, there is generally some standard of comparison; in the case of labor, the human factor plays such an important part that as yet there has been no definite standard established. The intuition, judgment, and experience of the employment manager are of the greatest importance, but there are a number of well-defined rules that may be laid down that will be of value to anyone who employs labor and who is responsible for hiring or dismissing men or women in industrial work. The following article is intended to lay down a few of these fundamental principles, and, in addition, to describe methods that have been used successfully by the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

Two Functions of the Employment Department

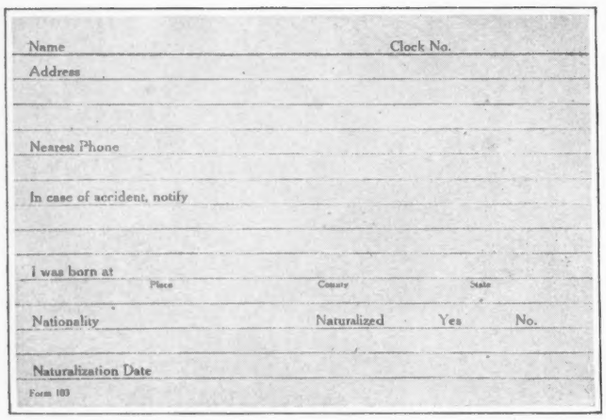
The employment department, as ordinarily conceived by most industrial managers, has no other duty to perform than that of hiring a suitable class of labor. This is a limited view of the functions of the employment department and one which will gradually disappear; it will be replaced with the idea that the employment department is responsible not merely for the hiring, but also for the maintenance of the labor force. In other words, the employment department serves two functions: First, to hire labor suitable for the work to be done; second, to keep the men and women that have been trained in the shop. In fact, the more experience an employment manager has, the more will he realize that the second of these functions is more important than the first. To hire men is comparatively easy, particularly when the supply of labor is reasonably abundant, but to keep the men that you have trained, so as to maintain a permanent force of experienced men, loyal to your concern, is a matter that requires considerably more tact, skill, knowledge of human nature, and experience in industrial work than does the mere hiring. Therefore, the following maxim may be laid down as the fundamental rule of successful employment management: Instead of hiring and firing, devote your main efforts to keeping the men once hired and trained in your shop.

The shop that hires inexperienced men, trains them, and then permits them to leave without making an effort to retain their services, is constantly subjected to a drain on its resources. When a trained man leaves the employ, the loss may be estimated at from $500 to $1000. It is impossible to determine in exact figures how great the loss is, but, by comparing the results obtained from new men with the results obtained from those experienced in the work of the concern, an estimate might be made.

Methods of Keeping Men

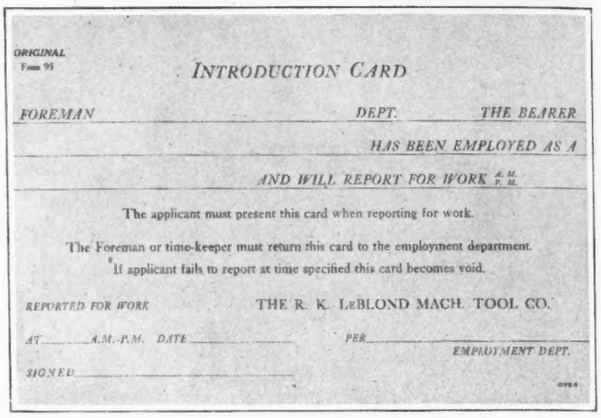
As the function of keeping the men once trained is considered more important than that of hiring men, this function will be first dealt with in detail. When a man gives notice that he expects to leave, the employment manager must find out exactly why he wants to change his employment. This must be done in a tactful manner, or it will be impossible in most cases to obtain the correct information. It is not always the pay that is at the bottom of the difficulty. There are many other matters that cause friction, and the employment manager must try to smooth out all small difficulties of this kind. There are political, religious, and racial questions that sometimes influence the decision. These must not be ignored, but must be tactfully handled. Sometimes it may be found to the best interest of the business to transfer a man to another department. The main thing is to carefully determine the exact causes why a man wants to leave, and having determined the cause, to tactfully remove, as far as possible, the difficulties in the way of an understanding between the men and foremen.

A valuable adjunct in keeping men loyal to your plant is found in the various activities generally classified as "welfare work." If properly handled and not given a paternalistic aspect this work is of the greatest importance. It adds to the comfort, health, and general efficiency of the workers and makes them realize that the firm is interested in something besides the actual product that they turn out, and creates a feeling of loyalty and cooperation between the men and the firm. Among the important features of this welfare work may be mentioned the maintenance of a first-aid room or, in a large plant, of a hospital, free dental service, restaurant service, insurance, as well as a systematic method of visiting men and their families when sick or otherwise in difficulties. It is of great importance that the company interests itself in the families of the men when there is sickness or other serious difficulties in the homes. The com-



Name Clock No.
Address
Nearest Phone
In case of accident, notify
I was born at
Place County State
Nationality Naturalized Yes No.
Naturalization Date
Form 103

Fig. 1. Application Blank which is filled in by the Employment Manager when interviewing an Applicant



ORIGINAL
Form 95

INTRODUCTION CARD

FOREMAN DEPT. THE BEARER
HAS BEEN EMPLOYED AS A
AND WILL REPORT FOR WORK A. M. P. M.

The applicant must present this card when reporting for work.

The Foreman or time-keeper must return this card to the employment department.

If applicant fails to report at time specified this card becomes void.

REPORTED FOR WORK THE R. K. LeBLOND MACH. TOOL CO.
AT A.M.-P.M. DATE PER
EMPLOYMENT DEPT.
SIGNED
over

Fig. 2. Employes' Introduction Card to be presented to Foreman of Department in which He is to work

pany which does this will keep its best men, because there is nothing that will appeal to a man more than an interest shown in those for whom he cares. Social features, such as bands and orchestras, glee clubs, bowling clubs, baseball clubs, annual outings, social evenings in an assembly hall within the plant, etc., also aid in bringing about a community spirit which creates good feeling all around.

In order to create the proper understanding of the aims and objects of the management, the employment manager should, from time to time, have talks with the foremen either in the form of a conference or private conversations, at which time he would lay before them the company's general policy and the reason for dealing with the men employed along the lines indicated. If every foreman becomes imbued with the spirit of friendship and cooperation toward the men, he can do more to win their loyalty toward the firm than can be done in any other way.

As an example of what can be done to hold a permanent trained labor force under trying and adverse conditions, the following case may be mentioned. When the R. K. LeBlond Machine Tool Co. moved from its old plant in Cincinnati to its new factory, it had to face this condition: Many of its older and most valuable employes had built and owned homes near the old plant. To travel by street cars to the new plant from their homes would take about an hour. This would naturally have a tendency to induce some of these men to seek employment nearer their homes. To prevent this, the company instituted a jitney bus service by which the men are carried for 5 cents directly to their home district, and as the busses can run "cross-town," the time is reduced to fifteen minutes, which has made it possible to retain practically all the desirable older employes.

Method of Hiring New Men

In hiring help, there are a number of points that have been found to be of great importance, although they may seem insignificant at first. Application blanks should not be filled out by the men or women applying for positions, at least not by those that are to be employed in the shop. Many of these men are not used to filling in blanks and are embarrassed, and the record obtained in this manner is seldom correct or of any particular value. Instead, personal interviews should be had, the interviewer making his own record on the blank provided, according to the answers that he receives to the questions he asks. Furthermore, the employment manager can draw many valuable conclusions from the manner in which his questions are answered, and he has an opportunity to "size up" the applicant, which he would not otherwise have. The only thing that the applicant should be required to do is to write his name in the space provided on the application blank. This gives a signature for identification, and as this signature has been written on the application blank in the presence of the employment manager at the end of the interview, there is a permanent record, not subject to dispute, which is of value in the future for identifying the signatures on the payroll receipts.

Arrangement of Employment Department

The employment department should have a separate entrance from the general entrance to the plant, and should have a separate waiting-room, which is heated in the winter and provided with chairs and a drinking fountain and other conveniences for the people that are required to wait until they may be interviewed. There is no reason why the men or women waiting for an interview with the employment manager should not be made as comfortable as possible while they are waiting. If the plant is large enough to warrant it, this waiting-room should be separate from the actual office of the employment manager, which, in turn, should be divided into two parts by a railing, the part outside of the railing being actually another waiting-room. The employment manager's desk should be placed at least fifteen feet from the gate in this railing, to give him an unobstructed view of the applicant as he proceeds from the railing to the desk. This is of considerable importance, as in this way the man that is to hire help may obtain a general impression of the physical appearance of the applicant. At the desk, the applicant is given a chair and made to feel at ease while he answers the questions put to him. Furthermore, the placing of the employment manager's desk a reasonable distance away from the railing makes it possible to interview the applicant without having those waiting outside hear the questions and answers. This puts the applicant at greater ease, and it is likely that the interview will result in a more accurate knowledge being obtained.

Present this card to the watchman at the entrance; he will direct you how to reach the place designated.

You will be given a booklet containing some rules and information. It is necessary that you read it. Your health and safety is of vital importance to your family, to yourself, and to us. We will do our best to insure your safety and guard your health, but we must have your help—start to help us by reading this booklet and abiding by its contents.

The First Aid Department is located in the office building. It is, in brief, a small modern hospital fitted up to take care of injuries of any nature, and is ready to serve you at all times. Make use of it when necessary.

I will read this booklet and agree to abide by the rules and regulations therein.

Signed _____

Machinery

Fig. 3. Back of Introduction Card shown in Fig. 2, on which Employe signs an Agreement to abide by the Rules of the Company

Qualifications of Employment Manager

It is a mistake to think that any clerk may be given the job of employment manager, because it is a class of work that requires more experience, tact, and knowledge of human nature than any other within the plant except

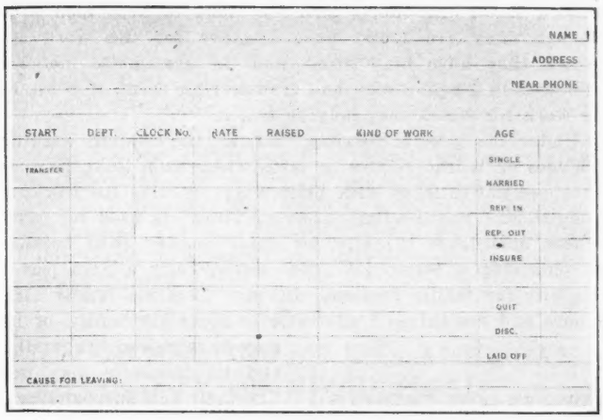


Fig. 4. Permanent Record of Employes

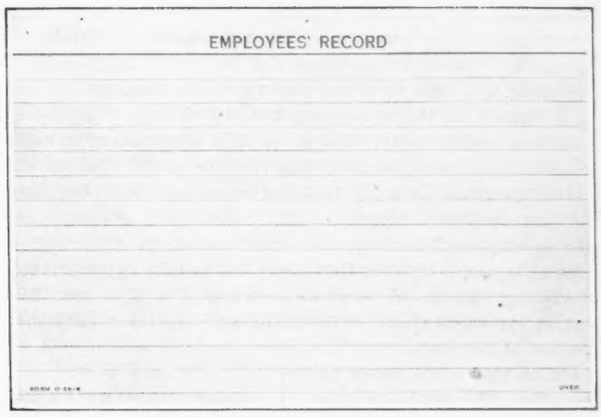


Fig. 5. Back of Card shown in Fig. 4

the general administration offices. It is of great advantage to the employment manager to have shop experience, because, in that case he can talk the "language" of the men whom he is to employ. He can place himself immediately in a position of confidence with the men, as they feel that they can talk with somebody who understands them and their work. It is also of great advantage to a man in this position to have a fairly accurate knowledge of the work

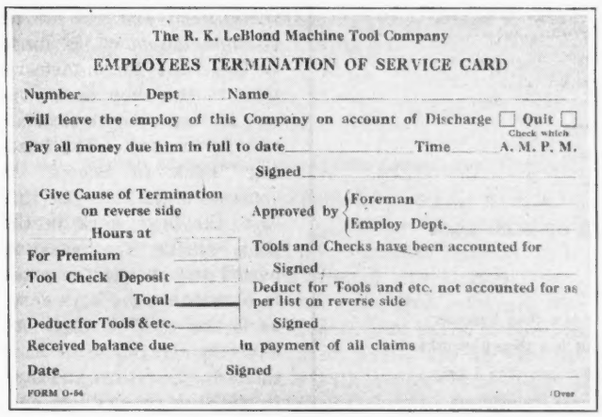

The R. K. LeBlond Machine Tool Company
EMPLOYEES TERMINATION OF SERVICE CARD
Number Dept Name
will leave the employ of this Company on account of Discharge ☐ Quit ☐
Check which
Pay all money due him in full to date Time A. M. P. M.
Signed
Give Cause of Termination on reverse side
Approved by Foreman
Employ Dept.
Hours at
For Premium
Tools and Checks have been accounted for
Tool Check Deposit
Signed
Total
Deduct for Tools and etc. not accounted for as per list on reverse side
Deduct for Tools & etc.
Signed
Received balance due in payment of all claims
Date
Signed
FORM O-54
(Over

Fig. 6. Employes' Termination of Service Card which is filled out when a Man leaves the Company's Employ

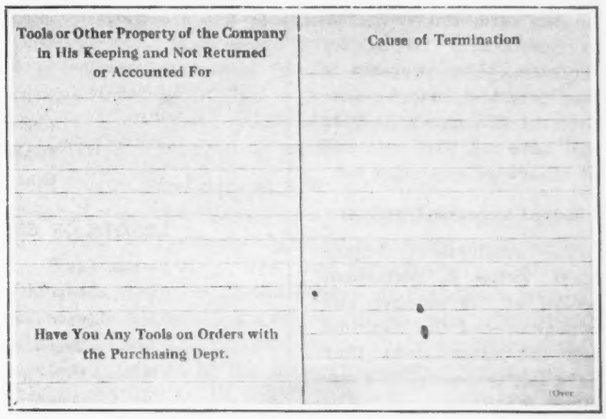

Tools or Other Property of the Company in His Keeping and Not Returned or Accounted For
Cause of Termination
Have You Any Tools on Orders with the Purchasing Dept.
(Over

Fig. 7. Back of Card shown in Fig. 6, giving Record of Tools in the Employe's Keeping and Causes for leaving

done in other plants in the same city and of the conditions in them. This gives him an opportunity to determine whether a man who states that he has had a number of years of experience with a certain firm would be suitable for the work for which he is to be hired. For example, a firm making fine instruments would have little use for the experience of a man who had been employed for years in a factory making rough coal-handling machinery. The actual shop experience on the part of the employment manager enables him to select men that are physically fit for certain jobs. He also knows what particular work requires great intelligence and can select men with a view to suitability in this respect.

Details of Employment System

As regards the actual details of the employment system, this, of course, has to be adjusted according to the individual needs of each firm. There is no need for a great many blanks or for a large and elaborate application sheet. The forms used by the R. K. LeBlond Machine Tool Co. are shown in the accompanying illustrations. Fig. 1 shows the application blank that is filled in by the employment manager as he interviews the applicant. Fig. 2 is the introduction card which is filled out by the employment manager in case he hires the applicant. There is an original and a duplicate of this form; the original card is kept in the em-

Department	Average Number of Men	ENTRANCES						EXITS																		
		New			Transferred			Quit							Transferred			Discharged						Unavoidable				
		Experienced	Learners	Laborers	Physical	Promoted	Failed	Wages or Work	Leaving Town	U.S. Service	Unknown	Better Job	Back to Farm	Back to School	Physical	Physical	Promoted	Failed	Lay Off too much	Drink	Undesirable	Physical	Insubordinate	Incompetent	Temporary Empl.	Laid Off	Death	Total Entrances	Total Exits
1																												
2																												
3																												
4																												
5																												

Machinery

Fig. 8. Permanent Record of Number of Men entering and leaving the Employ of the Company and the Causes for leaving

ployment office and the duplicate is given to the applicant to present to the foreman of the department in which he is to work. The foreman takes the card and after filling in the hour and date at which the applicant reported for work and signing in the space required, he returns it to the employment department; this gives this department a record that the man hired actually reported for work. On the back of the original (Fig. 3) there is some general information for the applicant, together with a space for his signature. He is supposed to read the information given before he signs his name, because this blank is retained by the employment department. A card, as shown in Fig. 4, is next filled out in the employment department and kept as a permanent record of the employe. The back of this card, as shown in Fig. 5, contains the man's record while in the company's employ. Finally, a form as shown in Fig. 6 is used to record when a man leaves the company's employ. Two squares are provided which are marked with a cross according to whether the man is discharged or leaves of his own account. The reverse side of this card, shown in Fig. 7, provides a record for tools and other property of the company which have been in the man's keeping and have not been returned or otherwise accounted for.

Record of Labor Turnover

The employment department keeps a permanent record of the number and percentages of the men lost and the causes why they have left the company's employ, as well as a record of men hired and men absent for any reason. This record is kept for each month by departments as shown in Fig. 8. The columns headed "Entrances" in Fig. 8 refer to men hired or transferred from one department to another, and the columns headed "Exits" refer to men who have left the company's employment either voluntarily or because of being discharged. It will be noted that "Transferred" appears under both the headings "Entrances" and "Exits." When a man is transferred from one department to another, he is recorded as an "exit" in one department and as an "entrance" in the department to which he passes.

Some of the column headings may require additional explanation. Under the heading "Transferred," the heading "Physical" refers to a condition where a man was not found to be suited for work in one department on account of lack of strength or other physical defect, but was suitable for work in another department where his physical qualifications were satisfactory. The heading "Failed" indicates that the man was found unsuitable for the work in one department because of inability to do that work—not for reasons of physical strength, but because of not being adapted to the work on account of mental qualifications. The mere fact that a column is provided for conditions of this kind in the record shows the efforts that are made to keep men even though they are found unsatisfactory for the work for which they have been hired, and the systematic methods followed in keeping men and transferring them, if possible, to work for which they may be suited.

Under the general heading "Exits," the column heading "Wages or Work" relates to cases where men leave because they are not satisfied with their wages or with the working conditions. The heading "Leaving Town" is used for cases where men leave the city for other reasons than because of obtaining a better job. Not infrequently a man leaves the city for family reasons. He may have his family elsewhere and not think it advisable to move his family, or he may have moved his family, and its members may not like their new surroundings. Many similar reasons are often met with. The heading "Back to Farm" is practically self-explanatory, but applies particularly in cities surrounded by farming communities. Many men come into the city and work during the winter and return to the farms for the summer. A record is kept of these men, and, as far as possible, an effort is made to have the same men return to the shop each winter, if they proved satisfactory in the past. The heading "Back to School" is somewhat similar. In this case, the boys work in the shop during the vacation period and an effort is made to have the same boys come back the next spring. An effort is also made to have them finally return and stay in the shop when their education has been completed. The heading "Unavoidable" refers to such causes as cannot be controlled, either by the firm or by the employe. The heading "Temporary Employment" refers to such work as is of a temporary nature, like building work, painting of buildings, excavation for foundations, etc. The heading "Laid Off" refers to men laid off because of lack of work.

CAUSES AND PERCENTAGES OF MEN LOST THEREBY

For *September* From *2* to *30,* 19*18*

DISCHARGED	Per Cent	QUIT	Per Cent
Lay Off too much	0.83	Account of Wages or Work	29.2
Account of Drink		Leaving Town	6.65
Undesirable	1.66	U. S. Service	6.65
Physical		Unknown	5.0
Insubordinate		Better Job	28.4
Incompetent	9.15	Back to Farm	4.15
		Back to School	2.5
		Physical	4.15
		Death	0.83
		Laid Off	0.83

Total Entrances *126*
Total Exits *120*
Gain *6*

LENGTH OF SERVICE OF MEN LOST

Per Cent	
21.7	Less than 1 week
21.7	Over 1 week but less than 1 month
30.0	Over 1 month but less than 6 months
12.0	Over 6 months but less than 1 year
5.0	Over 1 year but less than 2 years
5.8	Over 2 years but less than 3 years
2.0	Over 3 years but less than 4 years
	Over 4 years but less than 5 years
1.8	Over 5 years

PERCENTAGE OF ABSENTEES

	Per Cent
Minimum Absent	1.8
Maximum Absent	4.4
Average Absent	3.65

Labor turnover for month *12.8* per cent

Machinery

Fig. 9. Summary, in Percentages, of Turnover Record shown in Fig. 8

This record and all other statistics are compiled from a book called the "In and Out" book in which is entered each day all "entrances" and "exits," on the debit and credit system, as in regular bookkeeping. The entrance side contains the following headings: Date, Clock No., Name, Department, Kind of Work, and Source of Supply. The exit side has the following headings: Date, Clock No., Name, Length of Service, Kind of Work, Department, Quit, Discharged, Laid-off, and Cause. The value of this book is shown by the ease and despatch with which statistics that may not be taken care of by the regular method can be obtained.

A summary (in percentages) of the record shown in Fig. 8 is prepared as indicated in Fig. 9. This is self-explanatory. The figures are given for illustrative purposes only, and are not intended to convey an idea of actual "turnover." By means of such a record, it is possible to compare from month

to month the conditions of employment in the shop, the percentage of absentees, and, on the whole, all important conditions connected with the employment of the men. The percentages given under the headings "Discharged" and "Quit" are percentages of the total number of men who have left the company's employ. The percentages given under the heading "Percentage of Absentees" are percentages of the total number of men in the company's employ. Altogether this system has been found to work in a very satisfactory manner, and it is believed that the main principles laid down are fundamental to any successful method of hiring and keeping men.

* * *

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

At the annual meeting of the American Society of Mechanical Engineers, which was held at the Engineering Societies Building, 29 West 39th St., New York City, December 3–6, Mortimer E. Cooley, of Ann Arbor, Mich., was elected president, and F. R. Low, of New York, Henry B. Sargent, of New Haven, Conn., and John A. Stevens, of Lowell, Mass., vice-presidents. Charles L. Newcomb, of Holyoke, Mass., F. O. Wells, of Greenfield, Mass., and C. R. Richards, of Urbana, Ill, were elected managers.

At the machine shop session, papers were presented on "The British Engineering Standards Association"; "Work of the British Engineering Standards Association on Screw Threads and Limit Gages"; "Present Practice in Thread Gage Making"; "Measurement of Thread Gages"; and "Standards for Large Taper Shanks and Sockets."

British Engineering Standards Association

The paper relating to the British Engineering Standards Association was prepared by C. le Maistre, secretary of the association, and was presented by Brigadier General L. R. Kenyon, of the British War Mission in the United States. The association includes over nine hundred members, the object being to secure interchangeability of parts, to cheapen manufacture by the elimination of waste, and to expedite delivery. The association deals with standards relating to practically the whole field of engineering. As part of the work accomplished, the author mentioned in his paper the standardization of rolled steel sections, rails, automobile steels, screw thread tolerances, locomotives, electrical machinery, aircraft materials and parts, etc. The most recent activity of the association has been the standardization of details in the construction of ships and ship machinery. The funds for the work are provided by the Government and the industries concerned. The executive authority of the association is vested in a committee consisting of members appointed by the leading technical societies.

The work that has been done by the association on screw threads and limit gages was outlined by Sir Richard Glazebrook, director of the British National Physical Laboratory, in the second paper presented relating to the British Engineering Standards Association. This paper was read by H. J. Bingham Powell, of the British Inspection Department in the United States. In this paper, the author gave a resumé of the work done by the association on screw threads, with a view to securing interchangeability. The committee has arrived at the conclusion that the fit at top and root is in most cases unimportant, and that the important dimensions relate to pitch, angle diameter, and, to a less degree, to the angle of the thread groove. As to the form of thread, it is claimed that the rounded Whitworth form has distinct advantages from a manufacturing standpoint. The paper also gives attention to the design of gages for various elements of screw threads. Satisfactory forms have been developed for outside diameter, root diameter, pitch, angle, and radius of thread form, but no simple device has as yet been developed for the angle diameter.

Thread Gage Making

The paper entitled "Present Practice in Thread Gage Making," by Frank O. Wells, president of the Greenfield Tap & Die Corporation, Greenfield, Mass., described the difficulties experienced by manufacturers of thread gages in their efforts to maintain accuracy, and, at the same time, to meet present demands for increased production. Approved methods of cutting threads in a lathe, and of thread lapping, grinding, and testing, were described, and the question of tolerances was emphasized. An unreasonable and useless accuracy in a gage complicates the methods of gage making and increases the cost of the thread gages. Figures for tolerances, which are applicable in most practical cases, were presented. These tolerances were based on the number of threads per inch. For master gages, the following tolerances were recommended:

From 4 to 6 threads per inch, a tolerance of 0.0006 inch; from 7 to 18 threads per inch, a tolerance of 0.0004 inch; from 20 to 28 threads per inch, a tolerance of 0.0003 inch; from 30 to 80 threads per inch, a tolerance of 0.0002 inch.

For inspection gages, the tolerances would be slightly greater, and would be as follows:

From 4 to 6 threads per inch, a tolerance of 0.0009 inch; from 7 to 10 threads per inch, a tolerance of 0.0006 inch; from 11 to 18 threads per inch, a tolerance of 0.0004 inch; from 20 to 40 threads per inch, a tolerance of 0.0003 inch; from 44 to 80 threads per inch, a tolerance of 0.0002 inch.

These tolerances would be applied as "plus" tolerances in the case of "Go" male gages and "Not Go" female gages; and as "minus" tolerances in the case of "Not Go" male gages and "Go" female gages. The tolerances apply to angle diameters of all thread gages as well as to root diameters of templets or female thread gages.

Measurement of Thread Gages

In a paper on the "Measurement of Thread Gages," H. L. Van Keuren, chief of gage inspection of the Bureau of Standards, Washington, D. C., described the apparatus used and the methods employed at the Bureau of Standards for the measurement of thread gages. Formulas were also given in this paper for the computation of angle diameters from measurements taken by the three-wire method, for the U. S. standard, the Whitworth, and the Lowenherz threads. Various devices and accessories used in the measurement of the various elements of screw thread gages were also described.

Standards for Large Taper Shanks

In the paper presented by Luther D. Burlingame, industrial superintendent of the Brown & Sharpe Mfg. Co., Providence, R. I., on "Standards for Large Taper Shanks and Sockets," it was pointed out that the war needs demanded the construction of machine tools embodying taper shanks and sockets of larger dimensions than it had formerly been customary to use. Most of the tapers established in the early days had irregular variations in size and in depth and the application to the larger sizes of the rules followed in proportioning these earlier types does not give proper dimensions to meet the new conditions. To supply this deficiency, the Brown & Sharpe Mfg. Co., after a careful study of the present established tapers and of the experience of several prominent manufacturers, developed the set of standard tapers described at length in Mr. Burlingame's paper. In these tapers, the diameters at the large end vary from 4 to 14 inches and those at the small end, from 3¼ to 12 inches. The length of the taper is made equal to twice the diameter at the large end plus 4 inches, and the standard taper is ¾ inch per foot. Eight tapers are adopted as standards, numbered from 19 to 26, respectively, and having diameters at the large end as follows: 4, 5, 6, 7, 8, 10, 12, and 14 inches.

The meeting was well attended, and in addition to the interesting and constructive papers read on machine shop subjects, a number of papers of general interest were presented at the various sessions.

Making the American Hand Grenade

First of Two Articles on Methods of Machining and Loading the Bodies and Assembling the Bouchons

BY EDWARD K. HAMMOND

RECENT articles published in MACHINERY have described in detail the methods of machining and loading various types of shells that are fired from field guns, and the methods of making fuses for exploding these shells at exactly the required moment have also been described. The present article differs essentially from the preceding discussions of munition manufacture that have appeared in MACHINERY in that it deals with grenades which are thrown by hand instead of the types of shells which depend upon a charge of explosive to propel them from a gun. At the plant of the Gorham Mfg. Co., Providence, R. I., where data for use in compiling this article were obtained, many interesting methods are used in the production of this class of munitions, but before entering upon a description of the manufacturing practice, it is advisable to present a brief description of the parts of the hand grenade and the manner in which the parts function after the grenade has been thrown.

How the American Hand Grenade Operates

This article is concerned with the production of two types of hand grenades, which are known as the offensive and defensive types, respectively. The method in which both operate is essentially the same; the only difference in their construction is that different types of explosive-containers are used. The offensive grenade was designed for use in the open where the thrower would be exposed to the flying fragments of his own grenade if it were made like the defensive type described in the following. The container of the offensive type is made of waxed cartridge paper, which is blown to atoms by the explosion so that no dangerous fragments will fly back as well as forward. When one of these grenades is thrown, it is merely the concussion resulting from the explosion of the powder which is responsible for doing damage to the enemy. With the defensive type of grenade, the container is made of corrugated cast iron and, upon explosion, this container breaks up into 300 pieces, fragmentation being facilitated by the corrugated form of the container, so that the pieces of cast iron are thrown to a considerable distance and are likely to seriously injure or kill any men in the immediate proximity of the bursting grenade.

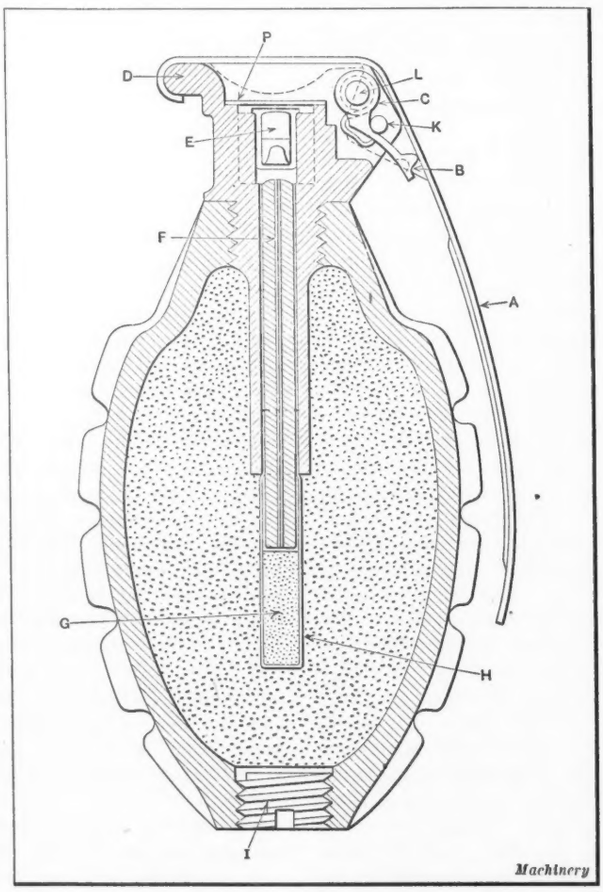


Fig. 1. Cross-sectional View of Defensive Type of Hand Grenade

In the case of either an offensive or defensive type of hand grenade, the method of igniting the explosive charge is the same, and a good idea of the way in which this result is accomplished may be obtained by reference to the cross-sectional view of the defensive type of grenade, which is shown in Fig. 1. In the illustration Fig. 2, at *M* is shown the container of an offensive grenade, while at *N* is shown the cast-iron container of the defensive type. Referring to the container shown at *M* it will be seen that it is made up of three parts: The cylindrical body *a* of waxed cartridge paper, the bottom *b* which is also of waxed paper, and the top of the container *c*, which is a die-casting composed of 90 per cent lead and 10 per cent antimony. Die-castings are also used in making the threaded plugs shown at *I*, which close the lower opening in the body of the defensive type of hand grenade shown at *N*. Wooden plugs shown at *Q* are used to close the top openings of the grenades after the powder charge is loaded into the containers

and before the detonating device is screwed in place. The other parts shown in Fig. 2 are common to both types of grenades, and when assembled, compose the complete detonating device which can be assembled with either the offensive or the defensive type of grenade body.

How the Hand Grenade Operates

At *K*, Fig. 1, is shown what is termed the safety pin. As long as this pin is in place, the grenade is inoperative. When it is desired to attack the enemy, the safety pin is drawn out of the grenade immediately before it is thrown. At *J*, Fig. 2, is shown a split ring, which is attached to pin *K* and which provides a means of withdrawing it very quickly. At the time the pin is withdrawn, care is taken to hold the grenade in such a way that the extension *A* of the cover is firmly held against the grenade body. The purpose of this cover is to hold back striker *B* against the tension of a coiled spring *C* until such a time as the grenade leaves the hand of the man who throws it. At this instant, spring *C* causes striker *B* to rise, thus throwing off the cover *A* by causing it to swing around its pivotal support *D*. When the cover is thrown off, there is no further obstruction in the way of striker *B*, and, as a result, spring *C* causes the conical projection of *B* to strike the cap in the primer *E*, which is loaded with a sufficient charge of fulminate of mercury to flash across and ignite the end of the slow powder train contained in the "2-inch 5-second" fuse *F*. It takes five seconds from the time that the grenade leaves the man who throws it until the explosion occurs, and the fuses used have been adjusted for this five-second interval because it has been found to allow sufficient time for the grenade to reach its objective point and explode among the enemy without allowing sufficient time for it to be picked up by the enemy and thrown back or out of the trench before the explosion takes place. When the fuse *F* has burned down to the extreme end, it ignites a detonator *G*. This is a standard blasting cap which consists of a charge of fulminate of mercury contained in a copper tube *H* that surrounds the fuse and contains this accelerating charge at its lower end. The explosion of the detonator results in instantly igniting the main charge in the grenade so that the explosion occurs under conditions that are favorable for enabling it to do the maximum amount of damage.

Fig. 3. Parts of the Defensive and Offensive Types of Hand Grenades with the Manufacture of which this Article is concerned

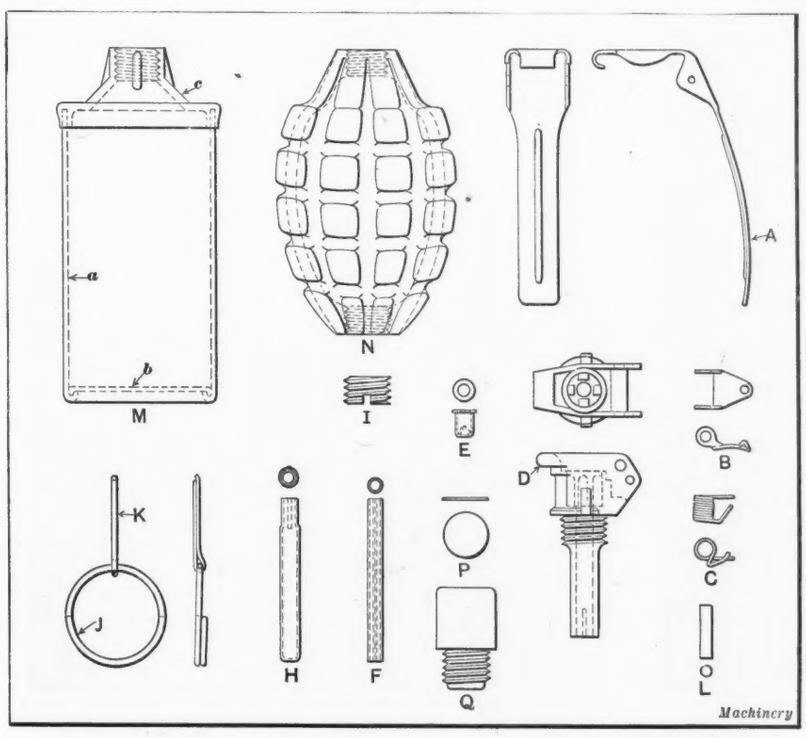


Fig. 2. Detailed Views of Parts of Defensive and Offensive Types of Hand Grenades

Gorham Mfg. Co.'s Practice in Making Hand Grenades

At the Gorham Mfg. Co.'s hand grenade plant, the following parts are furnished by the Government: The body casting of the defensive type and the completed body of the offensive type; the wooden plug *Q* (Fig. 2); the so-called "bouchon" *D;* the primer *E;* the fuse *F;* and the detonator *H*. The Government also furnishes the bursting charge and the packing boxes. These parts are made in other plants under government contract, and are the property of the United States Government when they are turned over to the Gorham hand grenade plant to be assembled, loaded, and packed in cases for shipment overseas. In order to provide for shipping loaded grenades to the battlefield with a minimum amount of risk, the practice is followed of shipping the bodies and detonators in separate boxes instead of assembling the detonator into the loaded grenade and packing the complete unit for shipment. As a result, the work of assembling and loading is subdivided as follows:

1. The castings for the defensive grenade bodies are delivered to the plant where the holes at the top and bottom are bored and tapped, and the surface above the top hole is also faced. Then a die-cast plug is screwed into the bottom hole and the bodies are loaded with a specially compounded powder, after which a wooden plug is screwed into the hole in the top of the casting.

2. The housing in which the primer

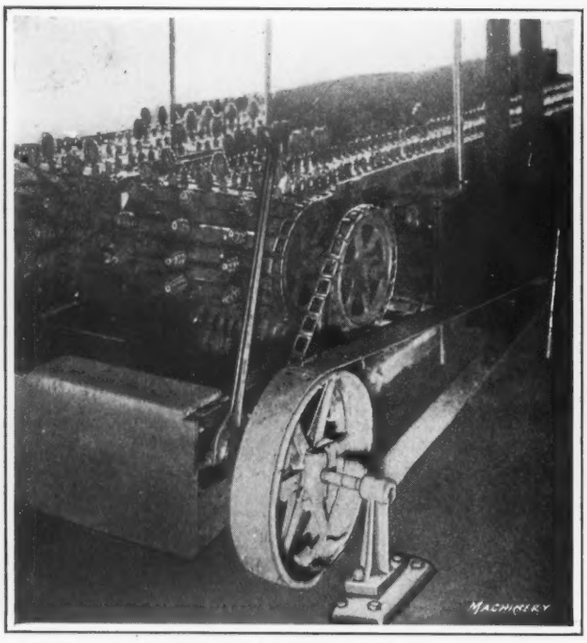


Fig. 4. Special Machine designed for Use in painting Grenade Bodies

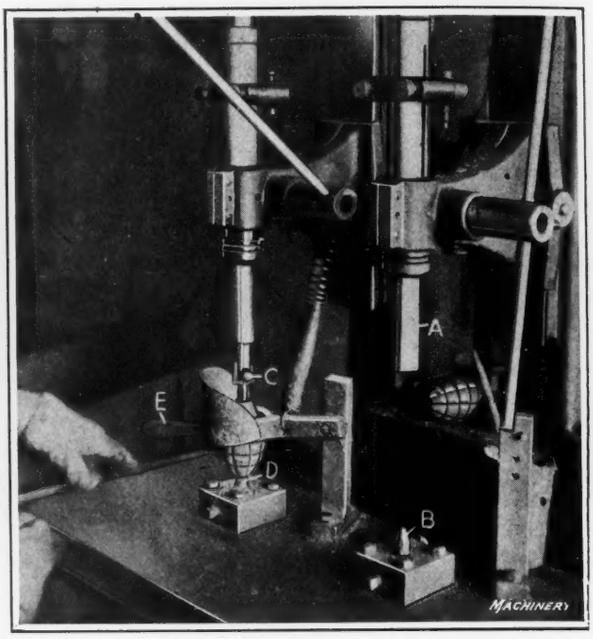


Fig. 5. Drilling Machine equipped for boring and facing Grenade Bodies

and detonator are assembled is known as a "bouchon," the name being derived from the French word for the stopper of a bottle, and hence, for the stopper for the upper opening of the grenade body. Parts of this member are assembled together, including the primer, fuse, and detonator, and then packed in cases ready for shipment. Cases containing loaded grenade bodies and loaded bouchon assemblies are sent to the battle-field, where it is an easy matter to remove the wooden plugs from the bodies and substitute the complete bouchon assemblies in their places. Then the grenades are ready for use as they may be required.

Machining Operations on the Defensive Grenade Bodies

The bodies of defensive hand grenades are made of gray cast iron and are corrugated, as shown in Figs. 1 and 2, in order to facilitate fragmentation of the body at the time that the explosion occurs. The earlier types were made of malleable iron, as by confining the gases generated by igniting the powder until a high pressure had been developed, a greater violence of the explosion resulted when the body finally burst. Fragments would sometimes fly as far as 200 yards. Owing to the more open nature of military operations in the later days, however, it became necessary to furnish a grenade which would more nearly approach the offensive type and which could be used in the open without endangering the thrower and his comrades too greatly. Gray iron bodies burst much more easily, and the velocity of the pieces was correspondingly lower.

As the body castings are received at the plant, they have a cored cavity in the center with a hole at each end that is left by the core prints. In preparing the bodies for loading, the first step is to paint them a gray color. The adoption of this gray color for a danger signal is interesting in that it is the British and French practice for designating

Fig. 6. Drilling Machine with Special Equipment for tapping Upper and Lower Holes in One Operation

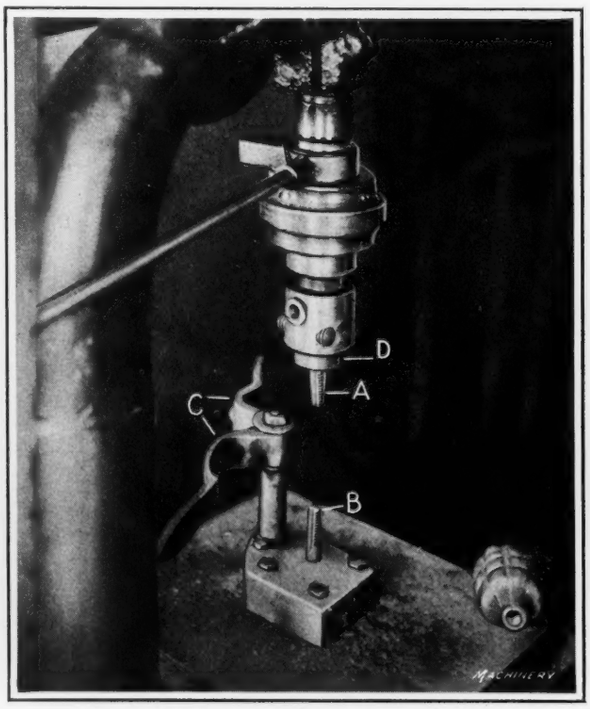


Fig. 7. Close View of Tooling of Drilling Machine illustrated in Fig. 6

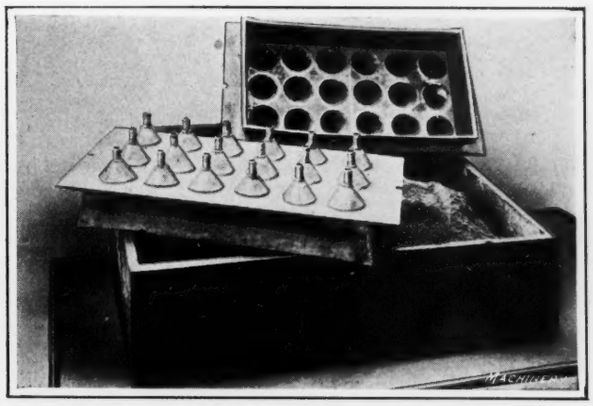


Fig. 8. Loading Box Inverted to receive the Hand Grenade Bodies, and Top View of Box in Background

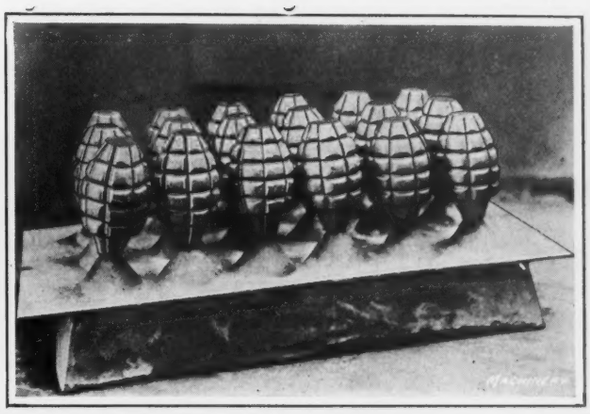


Fig. 9. Defensive Type of Hand Grenade Bodies in Place on Funnels of Loading Box before Box is inverted

live munitions. The dummy and practice pieces, on the other hand, are painted a bright red. It is said that the practice arose from the fact that when red was used for loaded pieces and the color was of poor enough quality to wear or rust off on exposure, several bad accidents occurred, due to the belief that the men were handling unloaded pieces. They are now taught that anything not painted a bright red must be handled carefully. The painting is done on a special machine, illustrated in Fig. 4, which consists of a conveyor system on which the grenade bodies are held by being slipped over spring clips which enter the hole at one end, in order to provide for carrying them through a vat full of paint. This paint is especially compounded with quick dryers, and after being dipped, the work goes over steam-heated coils which greatly facilitate the rate at which the paint dries.

The next step is to bore the cored holes at the top and bottom of the bodies, after which the surface above the top hole is faced to form a bearing for the flange on the bouchon which is screwed into this hole. Fig. 5 shows one of the two-spindle vertical drilling machines built by Charles G. Allen, which are employed for this purpose. It will be seen that the right-hand spindle is equipped with a four-lipped drill *A* with which both holes are drilled, and secured to the table of the machine there is a fixture provided with a pointed member *B* over which the work is located. Serrations on this point grip the lower opening in the work and prevent it from turning while the drill is machining the cored hole at the opposite end of the grenade body. After both holes have been drilled in this way, the work is transferred to the left-hand spindle of the machine which, it will be seen, is equipped with a facing tool *C* that is employed for finishing the surface above the top hole. The work is located over a pilot *D* which enters the lower hole, and a hand-clamp manipulated by handle *E* prevents the work from turning.

Both the upper and lower openings in the grenade body have to be tapped—the upper opening to receive the bouchon and the lower opening to receive a die-cast plug, shown at *I* in Fig. 1. An ingenious arrangement shown in Fig. 6 has been worked out to provide for tapping these two holes at a single operation by equipping a Barnes drilling machine with a special outfit which is more clearly shown in Fig. 7. Here it will be seen that there is one tap *A* carried in an Errington tapping attachment in the main spindle of the machine, while another tap *B* is mounted in a fixture secured to the drilling machine table. In tapping grenade bodies with this outfit, the method of procedure is as follows: A grenade is placed with the lower opening resting on the top of tap *B*, after which hand-clamp *C* is closed to grip the work and locate the upper opening under tap *A*. Then the spindle of the Errington tapping attachment is fed down so that the tap runs into the hole until collar *D* engages the finished surface above the top of the upper hole. It is then impossible for tap *A* to advance further into the hole in the work, and, as a result, the work commences to rotate so that it is screwed down over tap *B*, which cuts the required thread in the lower opening. After the lower opening has been tapped, the Errington tapping attachment reverses itself, and the first step is to back the work off tap *B*; then, when this result has been accomplished, clamp *C* is again tightened on the work to prevent it from rotating, so that tap *A* can be withdrawn. It will be apparent that with a machine equipped in this way a highly satisfactory rate of production can be obtained from machines placed under the care of inexperienced girl operators.

Loading the Grenade Bodies

Hand grenades are loaded with a special powder made by the Pennsylvania Trojan Powder Co., consisting largely of nitrated starch to which certain other constituents are added to give the explosive the required properties. In handling the work of loading, the plant has been laid out with particular attention to reducing, as far as possible,

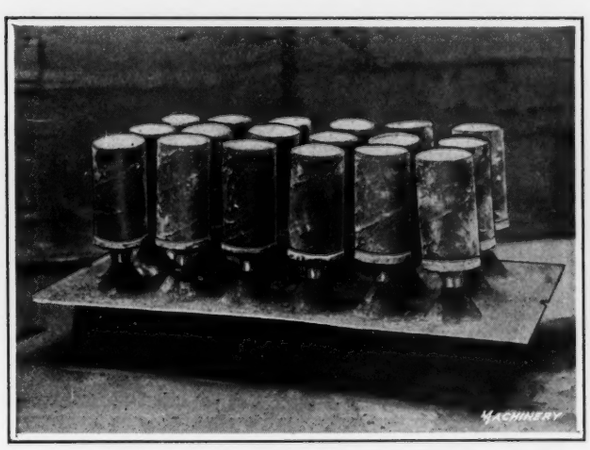


Fig. 10. Offensive Type of Hand Grenade Bodies in Place on Loading Box

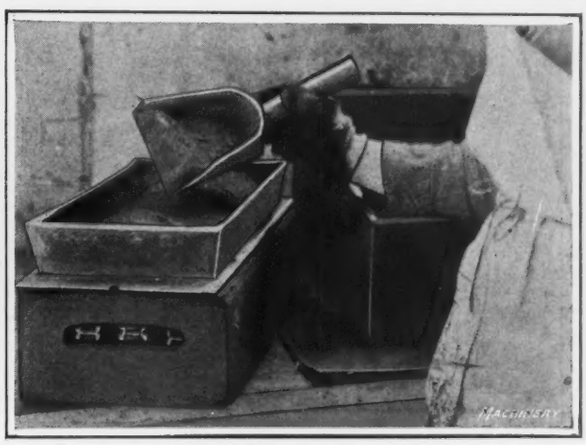


Fig. 11. Loading Box turned over Ready to be filled with Powder

Fig. 12. Two Loading Boxes clamped onto Vibrator to have Powder shaken down into Grenade Bodies

Fig. 13. Testing the Density of Powder in Loaded Grenade Bodies before inserting Wooden Plugs

the danger of an explosion or general conflagration which might result from any one operator's carelessness in causing the supply of powder placed at her disposal to be ignited. This is accomplished by having individual operators work in separate booths so that the occurrence of an explosion in any one booth would probably be sufficiently confined to prevent a general conflagration. For the purpose of this article, it will be best to describe the way in which the work of one individual loading booth is conducted. Each booth is subdivided into two compartments; namely, a loading and a vibrating compartment. Two girls are employed in the loading compartment and it is their duty to place the grenade bodies over the funnels of a loading box and deposit the necessary quantity of powder in this box to provide for filling the eighteen bodies which are supplied through the funnels.

At this point, it will be well to explain in detail the method of procedure followed by the girls employed in this booth. The loading box is placed upside down over the box of powder, as shown in Fig. 8, so that the funnels are in a convenient position to have the grenade bodies placed over them, as indicated in Figs. 9 and 10. When this has been done, a body box is placed over the grenade bodies, after which the two boxes and bodies are turned over to occupy the position illustrated in Fig. 11. One of the girls employed in the loading booth then takes a scoop and fills the loading box with powder so that this powder can run down through the funnels into the grenade bodies. The loading box and grenade bodies are then pushed through an opening in the wall that separates the loading compartment and the vibrating compartment, and, at this time, the girl in charge of the vibrator takes the loading box and places it on the table of the vibrating machine shown in Fig. 12 which provides a means of shaking the powder down through the funnels into the bodies of the grenades. The vibrator is so designed that it delivers 1200 shakes per minute to the work, and after being subjected to this treatment for a period of fifty seconds, the powder in the grenade bodies has been tamped down to a density of from 0.90 to 1.0. After vibrating, the loading box is lifted up so that the funnels are free of the openings in the grenade bodies, and this box is pushed back into the loading booth ready to have eighteen new bodies placed over the funnels. The lower box in which the grenade bodies are held is pushed through an opening in the outside of the vibrating booth, where the density of the load is determined by an inspector who uses a probe for this purpose as shown in Fig. 13. Unless any cause for complaint is found, wooden plugs are screwed by hand into the tops of the bodies, after

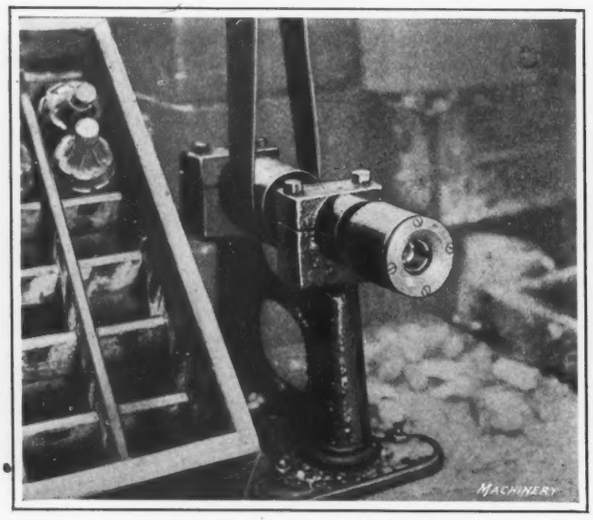


Fig. 14. Special Machine used for tightening up Wooden Plugs in Hand Grenade Bodies Ready for Shipment

Fig. 15. Packing Hand Grenade Bodies in Cases holding Twenty-four Ready for Shipment Overseas

which the entire box is placed on a belt conveyor which carries it to the packing room.

Screwing up the Wooden Plugs

When the boxes of grenade bodies reach the packing department, the first step is to screw up the wooden plugs, which is done by the use of machines of the type illustrated in Fig. 14. From this illustration, it will be seen that the machine is of very simple design, consisting essentially of a belt-driven spindle on which there is a chuck that grips the wooden plug in the grenade body. This chuck is furnished with three jaws which are free to slide inward against a compression spring; and as the jaws move inward, they are closed in on the wooden plug by means of a tapered bearing which engages the outer surface of the jaws. In using this machine, the operator grasps the grenade body and pushes the wooden plug into the chuck, causing the jaws to move inward and thus grip the plug so that it is screwed up into the work. When the plug has been screwed "home," the jaws slip and the operator, seeing that the operation has been completed, withdraws the work from the chuck. After the plugs have been screwed up in this way, the upper part of the grenade is dipped into melted paraffin to a point slightly above the plug, in order to seal the opening so as to effectually exclude moisture.

Packing Grenade Bodies for Shipment

After the grenade bodies have been sealed, they are ready to be packed for shipment, which is done according to the method partially shown in Fig. 15. Here it will be seen that each case contains twenty-four grenades. These boxes are furnished with two grooves running around them at points about 4 inches from each end, and into the grooves are placed bands of sheet metal. These bands are gripped by the special sealing device made by the Signode Seal Co., of Chicago, Ill., which first draws the band tight and then seals it. This method of packing may be very rapidly accomplished and has the additional advantage of affording a seal so that the box cannot be opened without making the fact evident.

In the second installment of this article, which will appear in the February number of MACHINERY, a detailed description will be given of methods which are used in assembling the bouchon, setting the fuse in place in the detonator, mounting the detonator in the bouchon, and packing the completely assembled bouchons for shipment to the battlefield.

* * *

ANNUAL MEETING OF THE AUTOMOTIVE ENGINEERS

The winter meeting of the Society of Automotive Engineers will be held in New York, February 4 to 6. These dates have been set as a matter of convenience to members of the society who might also desire to attend the New York automobile show which is to be held the first two weeks of February at the Madison Square Garden. The members who are engaged in automotive engineering at automobile, truck, tractor, airplane and motorboat production plants will thus have an opportunity to attend both the meeting of the society and the automobile show. The meeting will undoubtedly be the occasion of unusually interesting technical discussions of different automotive engineering problems, including that of fuel for internal combustion engines. A half day session will be devoted to the consideration of gasoline, kerosene, benzol, and other fuels. Representatives of the Government will present their latest data as to the fuel supply, and the results of recent intensive research in regard to fuel problems will be given. Men of acknowledged authority will also discuss this matter from the standpoint of engine design. Particulars never before made public concerning war automotive apparatus will be given in papers by members and others in the government service.

NATIONAL MACHINE TOOL BUILDERS' CONVENTION

At the National Machine Tool Builders' convention held at Hotel Astor, New York City, December 10–11, the greatest part of the time of the members was taken up by committee meetings at which the important problems at present facing the machine tool industry were thoroughly considered. There was only one general meeting during the convention —the opening meeting during the forenoon of the first day. At this meeting addresses were presented by F. C. Schwedtman, vice-president of the National City Bank, on "Financial Business Conditions"; by J. W. Hook, president of the Allied Machinery Co. of America, on "The Export Future of Machine Tools"; and by E. R. Webster, member of the firm of Price, Waterhouse & Co., on "An Analysis of the Present Tax Bill." The address presented by Mr. Hook is published in another part of this number. Resolutions relating to taxation problems were adopted by the convention, urging consideration on the part of Congress of the great menace now facing all industries due to the fact that both raw materials and finished goods that have been acquired at abnormal cost are carried on the inventories, and therefore show apparent profits which have not been realized and which probably never will be fully realized.

The following officers for the coming year were elected: A. E. Newton, Reed-Prentice Co., Worcester, Mass., president; A. H. Teuchter, Cincinnati Bickford Tool Co., Cincinnati, Ohio, first vice-president; E. J. Kearney, Kearney & Trecker Co., Milwaukee, Wis., second vice-president; C. Wood Walters, Cincinnati Milling Machine Co., Cincinnati, Ohio, secretary; Winslow Blanchard, Blanchard Machine Co., Cambridge, Mass., treasurer; and C. E. Hildreth, Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass., general manager. J. B. Doan, American Tool Works, Cincinnati, Ohio, past president of the association, was made an honorary member of the board.

* * *

LICENSES TO USE ENEMY-OWNED PATENTS

In the second session of the Sixty-fifth Congress, a bill was introduced by Mr. Fletcher, of Florida, to amend the "Trading with the Enemy Act" as regards provisions made for licensing American manufacturers to use enemy-owned patents. The proposed changes may be summarized as follows: The fee for a license remains fixed at a sum not to exceed $100, but it is proposed to eliminate the requirement that the licensee shall deposit an amount not exceeding 1 per cent of the fund required to be deposited with the Alien Property Custodian. The amount to be paid as royalty to the owner of the patent is to be determined in each case, instead of being fixed at 5 per cent. The new bill makes provision for protecting the licensee from infringements or interferences by persons who are not holders of licenses. Finally, it is proposed to provide only for the recovery of the reasonable royalty for the use of an enemy-owned patent which was determined at the time that the license was issued, and this is to constitute *prima facie* evidence of the reasonableness of the royalty. Provision under which a court might terminate a license upon filing of a suit by the owner of the patent, after peace is declared, is to be discontinued and the licenses will run for the full term of the patent. This affords manufacturers a reasonable opportunity to make investments in plant equipment, etc., without danger of suddenly having their rights terminated by legal proceedings. On November 15, this bill was referred to the Senate Committee on Commerce, and on November 21, it was reported without amendment. It is regarded as probable that the bill will be passed at the present session of Congress. Requests for information concerning the use of enemy-owned patents and applications for licenses should be addressed to the Federal Trade Commission, Washington, D. C. Classified lists of patents are now available for distribution.

Industrial Readjustment

Foreign Trade—Training the Crippled Soldier—Reconstruction Conference—Employment for Returning Soldiers and Sailors—Reconstruction Notes

FUTURE FOR MACHINE TOOL EXPORTS[1]

By J. W. HOOK, President Allied Machinery Co. of America

THE increase in the manufacturing capacity of America's machine tool industry, due to the war, amounts, it is stated, to about 100 per cent of its pre-war size. This increase is not alone represented in the enlargement of old established shops, but also in the creation of entirely new organizations which are ready to claim their share of the business. Now that the war is over and the demand from that source eliminated, the necessity for exploiting the foreign machine tool markets is greater than it ever has been. Our particular interest at this time may well be centered around the amount of business that we can obtain from these foreign markets. We are fairly well posted on the market that exists at home and know what it will absorb; then, knowing our capacity for production, we may obtain a fair idea of the surplus that is available for foreign consumption.

Past and Future Export Capacity Compared

Preceding the world war, our exports of machine tools reached a volume, in 1913, of $16,097,315, seventy per cent of which represented exports to Europe. The total manufacturing capacity of machine tools at the beginning of the war was, approximately $100,000,000 per year. During the four years of war, the exports rose until, in 1917, they struck the enormous volume of $84,935,410. This great increase was partially due to the increase of about fifty per cent in prices. On the basis of pre-war prices, this volume would be reduced to approximately $56,000,000, or about three and one-half times the exports during the years immediately preceding the war.

When the armistice with Germany was signed, the total producing capacity of the American machine tool industry, as nearly as we can estimate it, was about $400,000,000 per year. Reduced to pre-war costs, this would total about $250,000,000. Reduced further to a straight time-labor and pre-war basis, it would amount to about $200,000,000. Estimating domestic consumption for the next year on a pre-war basis at $100,000,000—and it surely cannot be more—we have a surplus left for export of an equal amount, or $100,000,000 pre-war value.

To sum up, the industry has in the past four years doubled in size, with a domestic market capable of absorbing only one-half of its output, and with an enormous surplus of machines in the hands of our latest customer, the United States Government, that must be disposed of. It is clear to all of us that the year ahead holds prospects of many serious problems.

Reasons for Great Expansion During War

When the war began, Germany, Austria, and Belgium were immediately eliminated from the machine tool field. All the belligerents were forced to turn their entire manufacturing capacity to the production of munitions of war. This meant that the demand for machine tools in France, England, Italy, and Russia had to be supplied by America. Germany and Austria, being shut off from the outside world, had to produce their own. The result, of course, was a tremendous increase in the American machine tool industry. It went forward by leaps and bounds, and its export market quickly assumed enormous proportions. England, Italy, France, and Russia bought millions of dollars worth of American machine tools. Then Russia went out of the war and her purchases immediately dropped to practically nothing.

The next step was America's entrance into the war, which resulted in the munitions industries of France, England, and Italy stopping expansion and leaving America to build a war machine greater than any that had yet been produced. This turned the tide back again from export to domestic business and left the great shops of our Allies practically fully equipped with American machines which were rapidly wearing out. So great was America's effort that practically the whole machine tool capacity of the nation was absorbed by it alone. Great government shops, equipped with millions of dollars worth of machine tools, were built here and in France. Hardly were these shops ready for operation when the war ended, leaving this vast quantity of machinery practically unused, on the Government's hands. Machine tool factories all over America also have millions of dollars worth of machines in process of manufacture.

What will Become of the Machine Tool Surplus?

Now the question is—what will become of this great surplus? Manifestly, it would be most dangerous to the industry as a whole if the Government, after dismantling its plants, should offer this machinery, as is the usual custom, to the highest bidder. On account of the great volume of tools that some manufacturers have supplied it would work a great hardship on them to buy all of it back. On the other hand, if the Government sells this material promiscuously, a great quantity of it will go into the hands of house-wrecking companies and curb-stone traders who are only interested in buying it cheaply in the first place and selling it at any price whatsoever, so long as that price yields them a profit.

Can the machine tool industry afford to have this thing happen? No, and it is to be sincerely hoped that definite action will be taken, looking toward a safe and sane method of disposing of all this machinery. Personally, I should like to see the Government make each manufacturer the special disposition agent of his own line for government account. This would mean, of course, that the Government would have to wait a little longer for its money, but is it not wise that it should? And does not the past loyalty of the machine tool builders of this country entitle them to liberal consideration?

Labor, also must be considered, and I think the Government would welcome some well-defined plan, looking toward keeping the machine tool industry going at a reasonable speed, in order that the army of labor which it commands may be kept employed. If the industry should be demoralized the labor employed in its plants could not be kept at work. Until this matter is settled the whole industry will be on

[1]Abstract of an address presented before the annual convention of the National Machine Tool Builders' Association, at Hotel Astor, New York City, December 10, 1918.

a basis of uncertainty. Machinery users all over the world are expecting a drop in prices and are slowing down on purchases. Machinery dealers, not knowing what machines will be thrown on the market any day, naturally are not ready to buy stocks without being protected by the manufacturer on the matter of prices. Once the policy of the Government is fixed, and provided it is a policy that will protect the manufacturer, buying will be resumed. My belief—and it is shared by many who have observed conditions abroad—is that we need have little fear of any surplus of machinery held by nations other than our own.

Future Trade Prospects

There is no reason to be pessimistic over the future of the machine tool industry. The large privately owned shops of the world are greater today than ever before. Their machinery is badly worn. Railroads in every country are needing equipment of every kind. The shelves of the world were never so barren. Thousands of shops of Belgium and northern France must be rebuilt; the coal and iron mines of France must be restored; the textile mills of Belgium must be re-equipped; sugar mills all over the world must be repaired; new roads must be made, and not an item of machinery required for these industries can be constructed without the aid of machine tools. What we need is a definite governmental policy looking toward a protection of machine tool prices, augmented, of course, by a great selling organization of the machine tool industry itself. With these assured, within a year the machine tool industry of America will enter again on a prosperous era.

Can We Compete with Europe?

The basic laws of all exporting, when conditions approaching normal arrive again, will apply to machine tools as well as to any other product. That America can compete in its manufactured products with Europe seems to me to be certain. We still have a distinct advantage in our method of manufacture over other countries. On account of her great domestic market, America has been able to develop manufacturing specialists. For instance, the manufacturer of milling machines in this country can develop a large and lucrative business in that line alone. The same is not true of other countries, where the local markets are more restricted. Investigation of the manufacturing industries of France and England proves this; seldom do we find a manufacturer there making but one line of goods. Even if this policy is changed in the future, it will require many years for Europe to overtake America. Mass production of specialties not only decreases labor costs and improves manufacturing methods, but also makes for a higher excellency of product and more rapid development and improvement in the machines themselves.

Another thing which the war taught America is the necessity of selling abroad from stocks on the ground. We cannot expect to compete without them. Extension of credit is another important factor, and, whereas we used to demand cash for our goods, we must in the future grant longer terms of credit than ever before. Thanks to the growing organizations of some of our biggest American banks, this will be perfectly convenient and possible.

Importance of Packing and Boxing for Export

Extremely important, too, is the necessity for crating our export shipments in the smallest possible space and in the most substantial manner. In hundreds of reports reviewed from all parts of the world, giving rules to follow in exporting, the main point of caution is in the matter of boxing. The Government, too, in its great over-seas shipments during the war, has been so impressed with the necessity of proper boxing and crating that it has issued a bulletin on the subject.

Following this, of course, is the matter of packing lists, containing necessary information to enable the foreign customer to get goods through customs without delay and at the lowest possible cost. In a great measure, American shippers have learned many things about exporting during the war. The necessity for maintaining an export trade will quickly place the basic rules of exporting beside the multiplication table in the intellect of American business. The need now is one of service, and no people in the world will go further to give real tangible and satisfying service to customers, when they once know what is wanted, than the people of America.

Commercial Considerations

The matter of exchange is also important from the standpoint of export business. Exchange simply means the value of the currency of one country in terms of currency of another. If the United States dollar is worth more than its normal value at any particular time, it means that your goods will cost your customer more in his own currency in proportion. This often puts the manufacturer at a disadvantage, and, unless his agent has some means of disposition of the native currency which is paid, other than by converting it immediately into dollars, native manufacturers can greatly undersell. This problem will, of course, be materially simplified when America begins to buy great quantities of foreign merchandise for delivery to all markets of the world. It will enable us to virtually trade in commodities, using exchange merely as a convenient expression of value. This will be possible when our merchant marine is plying all waters of the globe.

If we will study the methods employed by the two greatest merchant nations of the world before the war—England and Germany—we will find that England built up her great foreign business through merchant shipping and investment of money in foreign countries in industries that formed permanent markets for her merchandise. Germany obtained her foreign business through merchant shipping and salesmen combing every market of the world.

America, due to her growing merchant marine, and also to the fact that she is now the greatest creditor nation in the world, is in a position to combine the two methods above described. She will have to furnish means to rebuild the devastated regions of Europe. Her credit will be sought in South America and the Orient. Her growing merchandising firms even now are engaged in the task of extending their selling organizations to all markets of the world. Her ships are rapidly growing in number and, provided our seaman's lanes are amended to match with those of other countries, will soon be entering all ports of the world.

Sales Methods now and before the War

Before the war, strange as it may seem, the bulk of America's exports was controlled by foreigners. Several of the European countries, recognizing America's provinciality in the matter of the sale of her products, came to America and formed export houses of their own to sell American goods abroad. One such house did an annual import and export business with South America totalling $30,000,000 a year. Others obtained the exclusive selling rights of American manufacturers in the most important foreign fields.

When the war began, many manufacturers in this country, therefore, found their sales organizations in many of the best foreign markets completely destroyed. Then, and only then, did it dawn upon this country how dependent it was upon foreign export houses and sales agents for its export trade. The situation might have proved disastrous for much of our export trade had not the war assumed such gigantic proportions as to tax the manufacturing capacity of the entire world. The great demand for almost everything—machinery especially—afforded our manufacturers the opportunity to make new selling connections. The great expansion of the manufacturing capacity, which also followed, has, however, been fully equalled in the other belligerent countries; and protective measures of all kinds will be established to give their industries every possible advantage, to assist them in paying off their foreign debt.

Keen Competition to be Expected

We cannot expect to find the free markets that we enjoyed before the war. The nations, as a unit, are going to encourage their own manufacturers in every possible way. Already governmental purchasing organizations in France, England, Belgium, and Italy, have been created, whose duties are to consider most carefully and cautiously every item to be imported. National patriotism will be brought into play, and the native houses importing goods from other countries are in duty bound to buy what is needed in their own country if they possibly can. In France, they have already been asked to do this. In England, the leading manufacturers of machine tools have formed an alliance for the purpose of creating a world-selling organization of their own. They are opening their own branch offices wherever there is a sufficient demand for their products. This has already been done in France and Italy, and other branches will be opened as circumstances permit, each branch having a competent engineer as manager, and machine tool expert representatives appointed after careful selection.

For the present we can only hope to sell in those countries the things that are actually and immediately needed. Their doors today are practically closed against everything but raw materials. When this ban is removed, and we can reasonably expect that new trade treaties growing out of the peace conference will force it to be at least modified, we will need to have real American selling organizations on the job. These are necessary to insure the fullest loyalty to American goods and zest and industry in the art of selling.

If there was an incentive before the war for Germany to test the market with our machines and then make those machines herself, the incentive now is immensely greater. If any nation before the war could regulate the amount of American exports of machinery by controlling their sale, its incentive to do likewise, now that the war is over, is tremendously greater. It is a formidable barrier to foreign trade expansion that a manufacturer builds around himself when he entrusts his foreign selling to a foreigner. England and Germany followed no such method.

The Course America Must Pursue

The United States should be prepared with her own sales organizations. She should have her own export houses with selling branches in all markets of the world. She must assume the task of disposing of her own manufactured products. Herein, then, lies the answer to the manufacturer who asks, "What can I do to strengthen the nation's trade with foreign countries?" He must insist upon selling through American houses. He must insist so hard that an adequate number of such houses will be established to take care of his foreign business. The Webb bill provides for the creation of group selling organizations by manufacturers. Under its provisions, also, export houses can join with manufacturers for foreign trading. A movement of this kind on the part of our manufacturers will encourage the establishment of American houses in foreign countries. They, in turn, will encourage the establishment of banking facilities. Banking facilities will encourage investment in foreign securities and industries and, as these grow in size and number, America's influence will, likewise, greatly increase.

* * *

The Société des Ingénieurs Civils and a committee of the French Engineers' Congress have invited a delegation of American engineers to study in cooperation with French engineers certain problems involved in the restoration of France after the war. A delegation was appointed jointly by the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining Engineers. The representative of the American Society of Mechanical Engineers is Charles T. Main, former president of the society. The party of engineers sailed for France early in December and will remain there for some time.

TRAINING THE CRIPPLED SOLDIER

Following the example of France, which led the way in the fall of 1914, and later that of England, a tentative plan has been outlined in the United States for the training and instruction of the partially disabled soldier. Owing to the extensive facilities afforded by many of our institutions it will not, in all probability, be necessary to provide special institutions for training. There is no doubt, however, but that training and special instruction in the trades will be required, since it is safe to assume that a great proportion of these wounded men will seek preparation for permanent and lucrative work. And it should be so, for the fervor of patriotism and the present-day demands of industry will not otherwise always afford these men permanent employment which they should and must have. It is true that plenty of lucrative positions might now be found in which many of these men might fit, but conditions as they exist today will not always obtain.

The necessity of securing a man's job with a man's pay which will offer some promise of a future demands special training. With this purpose in view, the Federal Board of Vocational Education has planned the establishment of fourteen regional offices through which applications may be made for training. Men having various handicaps will necessarily need special equipment and attention, for which practical men will be required, both as instructors and for the purpose of providing means for overcoming, as much as possible, these handicaps. The regional offices will be in charge of representatives of the Federal Board whose duty will include not only the training but also the procuring of employment for the men. This employment should be of a highly specialized character, and the schedule should be so arranged that there will be diversified fields for which the men may be fitted. Any considerable number of men should not be placed in any one trade, for this might cause antagonism and industrial disturbances. Much individual attention will be required. Many more instructors will be needed than would be necessary if all the disabled men were of the same age and had the same disability. The plan will be expensive, but the results should be more than worth the cost.

All employers and others interested in the employment or training and employment of disabled soldiers and sailors, or desiring to help in any way in the work, should address their communications either to the Federal Board for Vocational Education, Washington, D. C., or to the District Office of the Federal Board in which the correspondent resides. Information concerning these districts and their respective offices follows:

District No. 1—Maine, Vermont, New Hampshire, Massachusetts, and Rhode Island. Office, Room 433, Tremont Bldg., Boston, Mass.

District No. 2—Connecticut, New York, and New Jersey. Office, Room 711, 280 Broadway, New York City.

District No. 3—Pennsylvania and Delaware. Office, 1000 Penn Square Bldg., Philadelphia, Pa.

District No. 4.—District of Columbia, Maryland, Virginia, and West Virginia. Office, 606 F St., N.W., Washington, D. C.

District No. 5—North Carolina, South Carolina, Georgia, and Florida. Office, Candler Bldg., Atlanta, Ga.

District No. 6—Alabama, Mississippi, and Louisiana. Office, 822 Maison Blanche Annex, New Orleans, La.

District No. 7—Ohio, Indiana, and Kentucky. Office, 906 Mercantile Library Bldg., Cincinnati, Ohio.

District No. 8—Michigan, Illinois, and Wisconsin. Office, Chicago, Ill.

District No. 9—Iowa, Nebraska, Kansas, and Missouri. Office, 517 Chemical Bldg., St. Louis, Mo.

District No. 10—Minnesota, North Dakota, and South Dakota. Office, Room 742, Metropolitan Bank Bldg., Minneapolis, Minn.

District No. 11—Wyoming, Colorado, New Mexico, and Utah. Office, 909 Seventeenth St., Denver, Colo.

District No. 12—California, Nevada, and Arizona. Office, San Francisco, Cal.

District No. 13—Montana, Idaho, Oregon, and Washington. Office, Seattle, Wash.

District No. 14—Arkansas, Oklahoma, and Texas. Office, Dallas, Tex.

DEVELOPING EXPORT TRADE TO FRANCE

An Interview with Arthur Geoffroy of New York, who Specializes in the Export of American Manufactured Products to France

France, in common with the other belligerent nations of Europe, will need American machine tools and other manufactured products in working out her reconstruction problems, and this demand will afford an excellent opportunity for manufacturers in this country to find an outlet for the product of the larger force of trained factory workers, and the increased plant capacity which was made necessary to meet the requirements of war-time trade. It has been the experience of firms doing a large export business from both this country and Europe that in order to develop foreign markets to the best advantage, it is highly important for the exporters to adopt methods of conducting transactions with their foreign customers which are in accordance with the commonly used business methods of those countries. A case in point arises in making exports to France. French business men are averse to paying for their goods until they have been received, and it is improbable that the establishment of credits to provide for discounting bills within ten days, which has been the war-time practice of the past four years, will be continued when we get back to a peace basis.

In France, it is the custom to make bills payable in sixty or ninety days, but in order to enable business men to keep their capital in liquid form, French business houses of the highest commercial rating are not at all averse to being drawn upon for the amounts represented by bills which will be due in two or three months. This enables the seller to draw upon his customer and take the draft to a bank where it can be discounted by paying 1/8 or 1/16 per cent of the face value. French business men do not regard the practice of drawing upon them as implying any question of the soundness of their credit, as would be the case with most American business firms, and so it is entirely feasible to handle financial transactions in this way instead of having to resort to the practice of borrowing from the bank upon notes issued by the sellers of goods, who would not be in need of money if they could liquidate their unpaid bills.

Arthur Geoffroy, 874 Broadway, New York City, who makes a specialty of selling American made goods to France, emphasizes the importance of handling export transactions on this basis. He also calls attention to the fact that many manufacturers of such products as safety pins and metal buttons, which call for the use of special machinery, could do a profitable business through licensing French manufacturers to use their machines on a royalty basis. Some American firms to whom this suggestion has been made, have been unfavorably impressed by the two facts that the use of their machines in France would enable the French market to be supplied by home production, and that there would be a possibility of utilizing cheaper French labor to produce the products of the machines for export to American markets. An analysis of reports of the export and import trade between America and France will show, however, that in the case of metal buttons, safety pins, and a great many other similar products, there has been very little exporting to or importing from France, so that it would appear that American manufacturers of such products need not fear that they would be inviting competition through allowing their machines to be used abroad.

Before the war, skilled French mechanics were earning from $1.50 to $2 a day, but under war-time conditions this wage has jumped to approximately $4 per day. It is doubtful if a substantial reduction in wages will be found possible for a number of years, and our tariff averaging approximately 35 per cent on manufactured metal products should afford ample protection to cover the difference in labor costs between France and America. At the same time, it does seem that the royalties obtained by American manufacturers from the use of their special machines would afford a substantial source of revenue without requiring the expenditure of capital in organizing and conducting sales campaigns.

RECONSTRUCTION CONFERENCE AT ATLANTIC CITY

At the Reconstruction Conference, held at Atlantic City early in December, in which nearly five thousand manufacturers and business men from all parts of the United States took part a definite expression was given of the present industrial trend of thought in the United States, and the requirements of the industries were recorded in a set of resolutions adopted at the last meeting of the conference. The organization and purpose of the meeting was described in the December number of MACHINERY, and the program was carried out essentially as there recorded. The addresses by H. A. Wheeler, Charles M. Schwab, John D. Rockefeller, Jr., James A. Farrell, and Secretary William C. Redfield all tended to give a definite idea as to the present conditions and requirements of the industries and the commerce of the United States.

Among the many resolutions adopted, the most important related to the prompt and equitable adjustment of claims in connection with the cancellation of war contracts; the disposal of raw materials or finished products now in the hands of the Government, to prevent violent dislocation of industry; the removal of war regulations of industry, and of other war restrictions, as speedily as practicable, save for such industries as are engaged in the production or distribution of foods and fuels; the permission of industrial cooperation, when through such cooperation waste may be eliminated and efficiency increased, permitting reasonable trade agreements; the development of public works of all kinds, in order that opportunities for employment may be created for unskilled labor that will be released from certain war industries; the reconsideration of the present taxation bill so that ability to pay, decreases in inventory values, and the amounts of revenue actually required for the coming year under the new conditions will be carefully weighed; the provision in any tax bill for allowing the taxpayer during present conditions to make a reduction from his apparent profit by way of a reserve for subsequent shrinkage in the value of merchandise; the enacting of legislation providing for the early return of all railroads to private management; the construction of a great merchant marine to be continued, and its operation under American control to be kept safe by such legislation as may be necessary to insure its stability and lasting value to American industries; the continued improvement of port facilities; the development of hydro-electric power stations so that the increased industrial activities of the nation may be able to avail themselves of an abundant supply of power; the encouraging and developing of foreign trade through all appropriate means possible, and especially the development of commercial and financial associations with other North and South American nations; and provision for the education of young men in the methods of foreign commerce and finance and in the practical use of foreign languages.

* * *

POSITIONS FOR MEN LEAVING ARMY AND NAVY SERVICE

The United States Employment Service has issued an appeal to employers on behalf of both the officers and the men who are ready to leave the army or naval service of the United States. With regard to the officers who will be released from active service, an appeal is made to employers in need of technical and other highly trained men, to take on qualified men from the commissioned ranks. Hundreds of officers are asking the Federal Employment Service to assist them in obtaining suitable employment.

There are also a large number of enlisted men qualified for professional and technical positions who are now leaving the army without having positions in sight. Among men of this type applying to the Federal Employment Service are engineers and other technical men, chemists, statisticians, purchasing agents, cost accountants, and employment man-

agers. Employers wishing further information on this subject should communicate with the Professional Section, United States Employment Service, Department of Labor, Washington, D. C.

In order to find work for the hundreds of thousands of soldiers who are now being released from the nation's service, the United States Employment Service is establishing a bureau for returning soldiers, sailors, and war workers in every city and town in the United States. While designed primarily for soldiers and sailors, in many communities these bureaus will also care for those civilians who have left their peace-time occupations to take positions with concerns engaged in doing war work. The returning soldier or sailor may call personally at the bureau and employers are urged, as a patriotic duty, to register their opportunities for employment at the central bureau that will be established by the Employment Service. Employers are asked to keep the bureau informed when positions are filled or when new jobs are open. The full resources of the bureau will be open without charge to all returning soldiers and sailors. The bureaus will bear a sign reading "Bureau for Returning Soldiers and Sailors. Conducted by the U. S. Employment Service and Cooperating Agencies." Discharged soldiers and sailors should go to their home towns after discharge where they will find these bureaus organized to help them to obtain employment.

In the work that the Government is endeavoring to do, it is being assisted by a number of the agencies such as the Red Cross, the Knights of Columbus, the Y. M. C. A., the Jewish Welfare Board, the Salvation Army, and others, that have done excellent work during the war on the behalf of the soldiers.

Employers are especially asked to note the following request: Employers who desire to employ a considerable number of discharged soldiers should immediately notify the Federal directors of the United States Employment Service for the states in which the work is located. Full details as to numbers and qualifications of men wanted, wages, hours, housing, and working conditions, etc., must accompany all such requests for men. A directory of the Federal directors, as well as of the local officers of the Employment Service, may be obtained by addressing the United States Employment Service, 916 Sixteenth St., Washington, D. C.

* * *

RECONSTRUCTION NOTES

With regard to the functions of the War Trade Board for the present and immediate future, Vance C. McCormick, chairman, has given out the following statement: "The War Trade Board has a function to perform until the peace treaty is signed. Under the terms of the Armistice the blockade of the enemy countries is maintained, and the control over exports and imports is to be exercised. Sufficient tonnage must be conserved by this control to supply the needs of our 2,000,000 troops overseas to guarantee them all possible protection and bring them safely home. There must be protection assured our allies, and the distressed and needy nations of Europe in the matter of supplies. When this work has been done international trade can be quickly restored. In the meantime the War Trade Board, in cooperation with the Allies, is relaxing just as far as possible every restriction which does not conflict with the above policy."

Steel Prices not to be Controlled by the Government

The War Industries Board has announced that, in view of the fact that the board ceased to function January 1, there will be no fixing of prices on iron and steel after that date. The price in force previous to that date expired on December 31, and although many industries have requested the Government to continue its price-fixing policy, nothing has been done to carry out this request. The action in connection with the iron and steel industry is in line with the policy of the Government to remove restrictions from all industries and abolish price-fixing agreements wherever such a course is possible. It is understood, however, that control over the exports and imports of steel and other commodities will be regulated by the War Trade Board for some months to come.

Reduction in Steel Prices Agreed Upon by Producers

At the recent meeting of the Iron and Steel Institute, Judge Gary, of the United States Steel Corporation, spoke enthusiastically on the future prospects of business for the iron and steel industry. The confidence in the future is also evident from the action taken by the steel makers with regard to price reductions as soon as it became known that the Government would not continue to fix prices. An average reduction of $4 per ton in steel prices, to take effect immediately, was announced by the steel makers, who have also given consideration to the desirability of combined action in establishing uniform minimum prices, but the latter plan has not been sanctioned by the War Industries Board.

Automobile Business Expected to be very Active

The manufacture of commercial and passenger automobiles has already been resumed in Detroit, where the motor car and accessory industries employ 140,000 men with an invested capital of more than $300,000,000. It is stated that there is a market for 1,000,000 passenger cars at once, or at least as soon as they can be produced. The only drawback, at the present time, is the lack of raw materials. It is stated that there is a shortage in both skilled and unskilled labor, with no prospect of relief until the non-war industries begin to absorb workers in the war industries in other cities. It is believed that the output of automobiles for 1919 will be about 2,000,000, this figure being based upon the production in 1917, which was over 1,700,000. Considering the curtailing in the building of automobiles for peace purposes during 1918, when less than 1,000,000 were constructed, it is believed that the demand for automobiles in 1919 may exceed the number that can be produced during the year.

Export Licenses

The War Trade Board is calling the attention of exporters to the necessity for being very careful, before shipping, to acquaint themselves thoroughly with the import requirements of the country of destination, as in some of these countries regulations which were in force during the war are still in full force and effect.

Information as to British import restrictions may be obtained by applying to the British War Mission, Munsey Bldg., Washington, D. C.; as to French import restrictions, to the French High Commission, 15th and M Sts., Washington, D. C.; and as to Italian import restrictions, to the Italian High Commission, 1712 New Hampshire Ave., Washington, D. C.

Exporters should also be careful to make the necessary freight arrangements before moving exports to these countries to seaboard. The shortage of shipping still prevents easy transportation from this country to the countries named; and the fact that an individual license is no longer required for any commodity except those named on the Export Conservation List should not be taken by exporters as an assurance that shipping space can or will be provided. Any information relating to the present requirements imposed by the United States Government may be obtained by addressing Vance C. McCormick, chairman, War Trade Board, Washington, D. C.

* * *

The Engineering Council of the United Engineering Societies, 29 W. 39th St., New York City, has organized an Engineering Societies' Employment Bureau which will absorb the separate activities of each of the national engineering organizations represented by the council with regard to placing individuals in touch with available positions. Walter V. Brown has been appointed secretary of the bureau.

LETTERS ON PRACTICAL SUBJECTS

WE PAY ONLY FOR ARTICLES PUBLISHED EXCLUSIVELY IN MACHINERY

BROACHING CHUCK BODIES IN A HYDRAULIC PRESS

The shell of the chuck shown in Fig. 1 is a rather difficult piece to make where a slotter or other machine suitable for quick production work of this class is not available. In this case, an adjustable broach, shown in Fig. 2, was used in

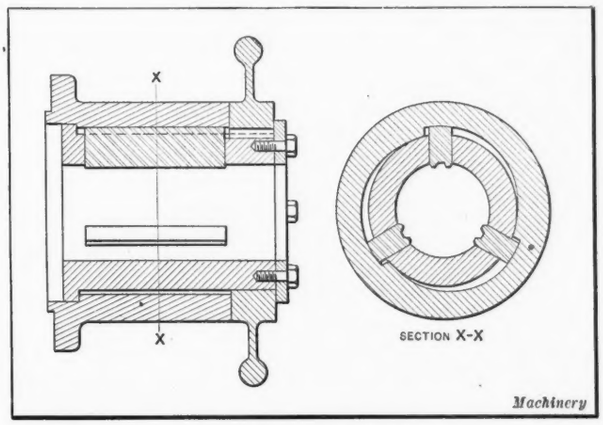


Fig. 1. Shell Chuck to be made

a hydraulic press with very satisfactory results. Of course, there is a slight breaking away of the iron as the broach is almost through the work, but this is cleaned away by counterboring. The body of this chuck has three internal cam surfaces, as shown in section X–X, Fig. 1.

The broaching cutter is made of tool steel and was first turned up into a ring as shown in Fig. 3, the outside diameter

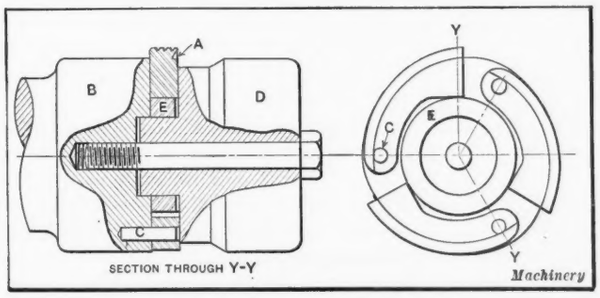


Fig. 2. Broach used in making Shell Chuck

of which was enough larger than the body of the holder to produce a cam surface of the proper depth and to leave enough of the concentric land to act as a guide for the steel jaw retaining sleeve. The shape of the three cutters *A* and the holes were then laid out as shown. After these cutters were cut out they were hardened and drawn to a straw color; as they retained their true shape, grinding was unnecessary. They were then set on the body *B*, Fig. 2. The pins *C* that hold the cutters are so located that the broach will form the proper cam surface when the cutters are in the expanded position. The body *B* is counterbored

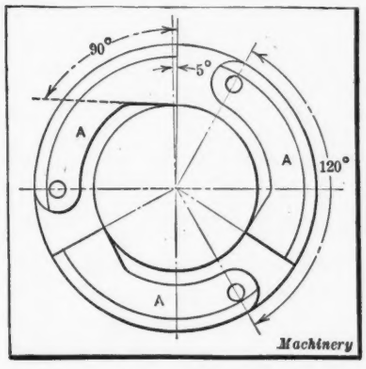


Fig. 3. Method of laying out Broaches

to receive the boss on the pilot *D*, which is relieved to make chip room under the cutting edge; provision is also made for the chips to drop through out of the way, as any clogging will tear the work, and the chances are that the broach would break. Four rings *E* were also made, the inside diameter being such that they fit on the pilot boss, and the outside diameters varying by 1/16 inch. The smallest ring is used first; in this operation, the broach removes 1/32 inch of the metal. This ring is then replaced by the next larger and so on until the four are used. To be on the safe side, the last setting is put through three times, the broach being turned 120 degrees each time. A good finish, as well as sufficient accuracy, is thereby obtained. For a half dozen or more chucks, this method will be found economical.

Medicine Hat, Alberta, Canada — JACK HOMEWOOD

INDEXING THE TECHNICAL LIBRARY

Technical magazines, when bound in yearly or semi-yearly volumes, make excellent technical reference and text-books.

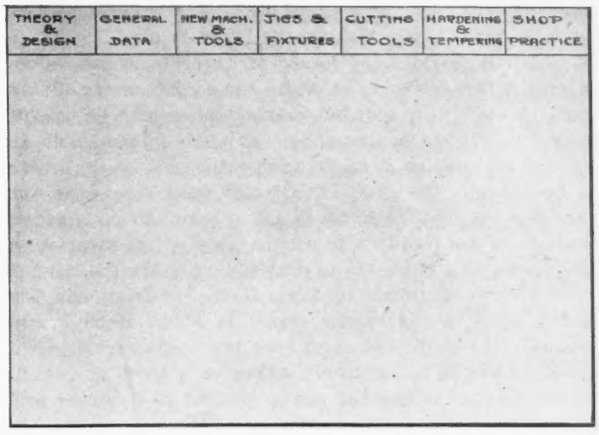


Fig. 1. Classification Card used in indexing Technical Literature

The writer has accumulated such literature for five or six years, and has found it invaluable. The most important feature of these books, however, is the index; the set would

M

DESCRIPTION	PUBLICATION
GARVIN MILLING MACH. WITH RGHG. SPINDLE.	MCHRY., JULY, 1913, PAGE 804.
ROCKFORD, No. 0 PLAIN MILL. MACH.	MCHRY., JULY, 1913, PAGE 809.
BURKE MILL. MACH (BUSHING SPLITTER)	MCHRY., JULY, 1913, PAGE 811.
THURSTON MILLING MACH. (DIE MILLING)	MCHRY., SEPT., 1913, PAGE 61.
FOSDICK MILL MACH. (COMB. BORING DRILLING)	MCHRY., OCT., 1913, PAGE 130.
OESTERLEIN UNIVERSAL & PLAIN MILL. MACH.	MCHRY., OCT., 1913, PAGE 136.
GARRIGUS NO. 2 HAND MILL. MACH.	MCHRY., OCT., 1913, PAGE 164.
NEWTON FIVE SPINDLE MILL MACH.	MCHRY., OCT., 1913, PAGE 165.
PORTER CABLE UNIV. MILLING ATTACHMENT	MCHRY., NOV., 1913, PAGE 244.
UNIVERSAL SCREW MILLING MACH.	MCHRY., DEC., 1913, PAGE 317.
GARVIN VERTICAL SPINDLE MILL. MACH.	MCHRY., JAN, 1914, PAGE 416.
CLEVELAND ROTARY TILTING MAGAZINE.	MCHRY., FEB., 1914, PAGE 511.
ROWBOTTOM MILLING MACHINE (CAM)	MCHRY., MAR., 1914, PAGE 596.

Fig. 2. Index Card on which are listed Articles on a Given Subject and Magazines or Books in which they appeared

be of no use whatever without a complete system of indexing. A designer or engineer may have ever so many volumes of technical literature in his bookcase, but if the library is not properly indexed it will be practically useless as far as immediate reference is concerned. When confronted with a certain problem in design, it is necessary for one to be able

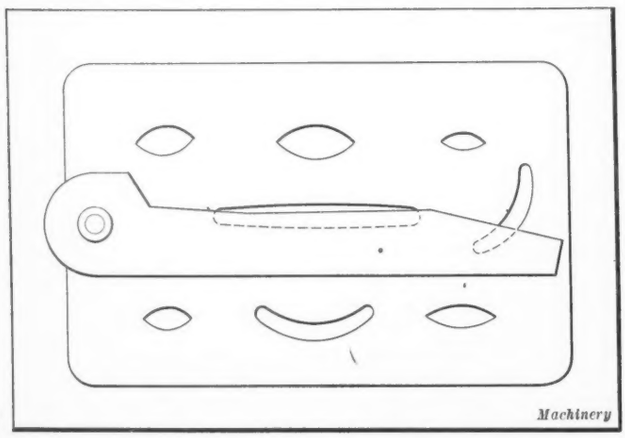
to refer quickly to some similar case, or to some data regarding the work in question.

The system described here has been found very satisfactory. Standard 5- by 8-inch index cards are used, and the subjects are filed alphabetically. In the rear of the file is placed a classification card, Fig. 1, which is one-half inch higher than the index cards, so that the classifications may be plainly seen. A marker *A* is placed on top of each index card, as shown in Fig. 2, to show its classification. For instance, the card shown would be placed under M in the file, but the marker would show it to be classified under "New Machinery and Tools." A few minutes' study will show the simplicity of this system. After the index cards are filed, it will be easy to locate any particular branch of work almost instantly, as the markers of each classification all line up perfectly with each other. This has been found to be a simple and serviceable index, and if kept up each month as the magazines arrive, will be very little trouble. It can be used to index all literature on hand of any technical value and can be added to at any time.

Chicago, Ill. WILLIAM G. MUELLER

ERASING SHIELD FOR CORRECTING TRACINGS

Where it is necessary to make frequent changes or corrections on large tracings, the writer has found that the use of an erasing shield saves much time and makes it possible to erase only what is desired. For this purpose the thinnest brass shield that can be found is used, to one end of which is fastened, by means of an ordinary zinc eyelet, a strip of thin brass, as shown in the accompanying illustration. A piece of a worn-out erasing shield may be used for this strip. It can be swung over any hole in the shield and its size adjusted so as to just cover the part of the tracing to be erased. The brass shield and strip soon wear very thin and hug the cloth closely, thus permitting a clean-cut erasure to be made. The writer uses a fine-grained ink eraser—never a knife—as no matter how sharp the latter is, it will leave a rough surface. If the drawing has been erased often, a red rubber eraser is used. Much erasing roughens the cloth, and so to keep the tracing from getting soiled, it might be lightly rubbed with a piece of paraffin, which absorbs the dirt and can be scraped off if a clear print



Erasing Shield for Use in correcting Tracings

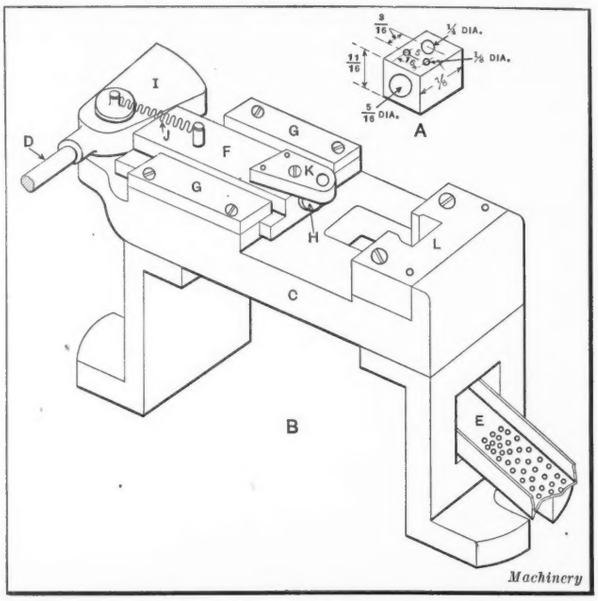
is desired. It must also be carefully scraped off if the tracing is to be further changed, as the paraffin prevents the cloth from taking the ink.

Terre Haute, Ind. SIDNEY REIBEL

JIGS FOR DRILLING CAST-IRON BLOCKS

At a time when work was not as plentiful as it is now, a certain company took the job of drilling 50,000 blocks of the size shown at *A* in the accompanying illustration. These blocks were of gray iron, and when received, were machined all over and accurate within ± 0.005 inch. The drilling was performed in two operations; the two 1/8-inch holes and the 1/4-inch hole were drilled simultaneously in the first operation, the 5/16-inch hole being drilled in the second operation. This order of drilling was necessary, as the 1/8-inch drills would have been deflected by cutting into the larger hole, but the 5/16-inch drill having a larger diameter was not affected by cutting into the smaller holes.

The first problem was to design jigs for holding the blocks that would require the minimum amount of time in loading



Jig for holding Cast-iron Blocks while drilling

and unloading. At *B* is shown the jig that was designed and used successfully for drilling the 5/16-inch hole. It is similar in design and operation to the one that was used for drilling the two 1/8-inch holes and the 1/4-inch hole. The jig, as shown, consists of the cast-iron body *C*, which is set on legs five inches high in order to provide hand room for using the handle *D*, and also to give a sharper angle to the discharge chute *E*, and at the same time to provide clearance for the receiving box at the end of the chute.

The slide or movable jaw *F* is made a close sliding fit in the body *C* and is held in place by pieces *G*. Jaw *F* carries at the forward end the hardened wearing piece *H* and the templet *K* for guiding the drill, the templet *K* being attached to the movable jaw in this case to allow greater freedom in loading. Sliding jaw *F* is closed upon the work by the movement of the cam *I*, which is of such shape as to give a powerful grip to the jaws, a wide loading space, and a quick movement. Tension spring *J* holds the slide back, leaving the jaws always in an open position, except when forced together by means of pressure exerting on the hand-lever *D*. A carbon steel locating piece *L* is doweled to the body to receive the blocks; it is accurately lined up with the hole in templet *K*. The block when in place rests on a half floor extending across and in front of the opening in *L*. Just in front of this is the large opening into which the blocks fall, and beneath which the chute *E* is placed. A light spring, not shown, knocks the blocks off into the opening when the slide *F* is withdrawn, and they slide down the chute into the receiving box. It is only necessary for the operator to place the block in the jig and feed the drill to the work. Brushes are unnecessary, as the chips clear themselves and the blocks are freed from chips as they slide over the perforated section of chute *E*.

For drilling the three holes in the sides, a Sellew drill head is used and the piece is held in a jig which is a duplicate of the one shown, except that the templet which guides the drills is attached to the stationary jaw and is provided with three holes for guiding the three drills.

Middletown, N. Y. DONALD A. HAMPSON

TURNING A TWO-THROW 90-DEGREE ENGINE CRANKSHAFT

The methods shown in the accompanying illustrations have proved successful in overcoming the difficulties met with in eccentric or offset turning; that is, turning in which there is more than one axis and consequently more than one pair of centers. The illustrations show the turning of a two-throw 90-degree engine crankshaft. The crank

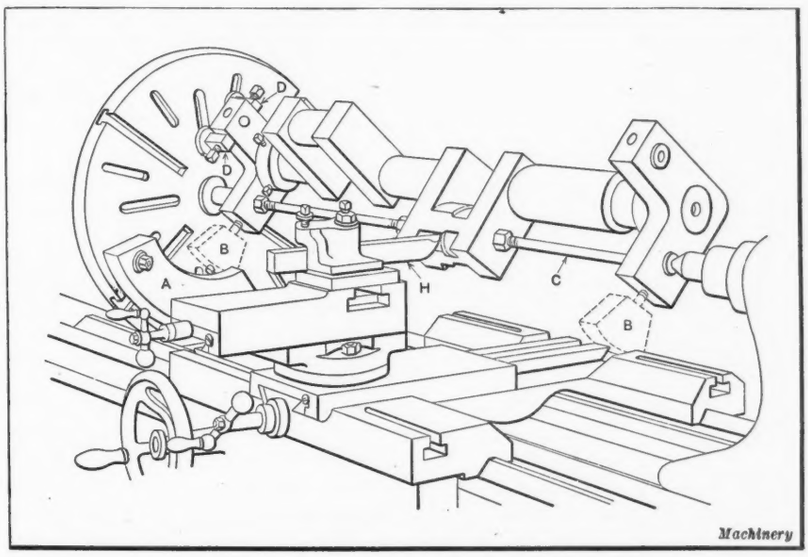


Fig. 1. Method of turning a Two-throw, 90-degree Engine Crankshaft

fixtures may be counterbalanced by using a weight *A* fastened to the faceplate, though preferably by means of adjustable weights *B* attached to the work. A jack, or braces, *C* should support the work opposite the centers, especially when the crankshafts are slender. A piece of leather placed beneath the driver *D* will reduce all jars. To overcome the vibration of the tool when it must extend far out to avoid the hub of the crankshaft, as shown at *H*, Fig. 1, the fixture shown in Fig. 2 was made and placed on the cross-slide, after the original compound rest had been removed. The tool *E* is fitted into the machined part *F* of the fixture, so as to prevent any side movement, and is held firmly in place by a clamp *G*. With this fixture very short pieces of carbon-steel tools can be used.

Brooklyn, N. Y. A. J. CAHEN

A CHEAP BELT CLEANER

While visiting a factory recently, the writer noticed several cans of "Kitchen Klenzer" among the machine supplies, and wishing to know to what use this preparation was put, he questioned the foreman of the department. For answer the foreman walked over to a machine and rubbed a thick coating of oil on the contact side of the driving belt; he then started the machine and the belt immediately began to slip. Taking a can of "Kitchen Klenzer" he sprinkled some of the preparation on the belt. After this was done he let the machine run for a few minutes, and then, bringing the machine to a stop, called attention to the fact that the oil had disappeared from the belt. The powder had absorbed all the oil and then worked off the belt leaving it clean.

The foreman explained that he found out about the belt cleaner through an agent who came into the plant one day with a can of "Quick Belt Cleaner." After a demonstration of the efficiency of his powder, the company purchased several cans. A short time afterward, the label on the can, having become oil-soaked, was removed, and it revealed the original label "Kitchen Klenzer." The agent's label had simply been pasted over the original label. As the agent charged 30 cents a can and "Kitchen Klenzer" can be bought at almost any grocery store for 5 cents a can, it is needless to say that he did no more business with the company.

Aurora, Ill. JOHN J. BORKENHAGEN

THE SPIDER AS AN ENGINEER

On a cobwebbed window in an old shed a spider had trapped a fly. The spider was small and insignificant and the fly was large and vigorous, so that the outcome of the contest seemed sufficiently uncertain to excite interest as to the results. The spider went through the usual process of deftly and firmly fastening the fly—first the leg which had become entangled in the web, then the other legs, and finally the wings were bound so that the fly became entirely helpless. The writer was about to leave, thinking this was the end, when he saw that the spider had further plans. In the ceiling, two feet above the web, there was a hole and the spider made repeated trips back and forth, to and from this hole, gradually making a "cable" by adding strand after strand, thus connecting the fly to the ceiling at the edge of the hole. After the cable had been made sufficiently strong, the spider commenced breaking and cutting away the many strands which connected the fly to the web. When the last one was cut the fly swung free in the air, hanging by the cable from the ceiling.

The spider then went to the upper end of the cable and

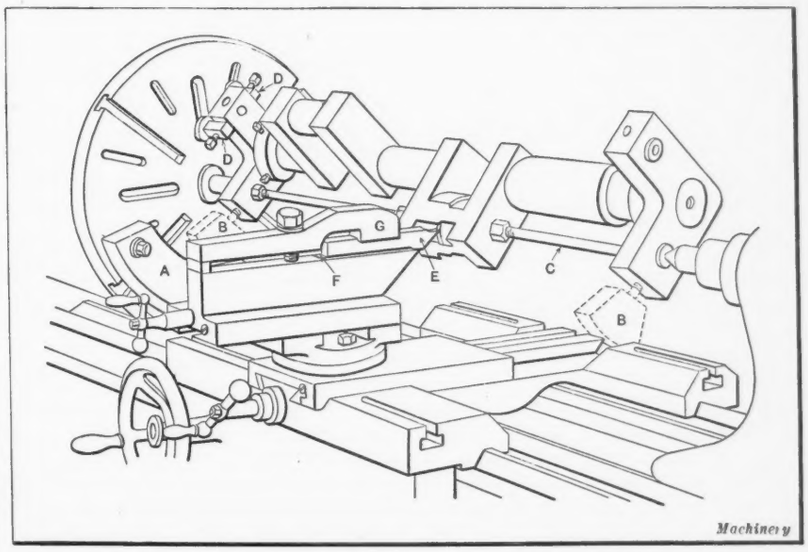


Fig. 2. Tool-holding Fixture for Use when turning Crankshafts

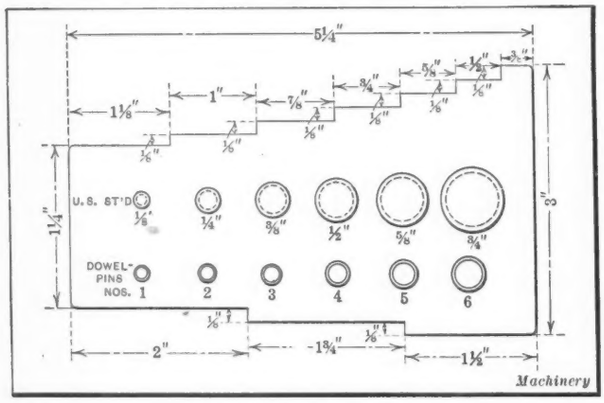
drew it up "hand over hand" until the fly was drawn into the hole above. During this complete operation there did not seem to be a single misdirected or lost motion, or any hesitation as to the right thing to do at the right time, and in a few minutes from the time the fly was first entangled in the web, it was safely stowed away. This is but one illustration of many that have come to the writer's attention in years of study of insect and animal life which shows what a difficult matter it is to draw the line between instinct and intelligence. It is hard to believe that these

operations could have been carried through in the way in which they were observed unless reasoning power were added to instinct. The writer has seen many a man with no more difficult engineering problem to solve work with far less intelligence in handling it.

Providence, R. I. LUTHER D. BURLINGAME

A HANDY GAGE

A gage that will be found very handy by stock-room attendants is shown in the accompanying illustration. It is made from tool steel, hardened and ground, and has tapped holes in it to fit various sizes of U. S. standard screws, as well as taper holes for the different sizes of dowel-pins. By means of the notches cut on the edges, the standard diam-



Convenient Stock-room Gage

eters of bar stock from 3/8 inch to 3 inches may be readily obtained.

New Haven, Conn. ERIC LEE

SWING VEES IN JIGS AND FIXTURES

In most cases in jig construction, swing locating vees can be applied to better advantage than the sliding type. The swing vee, when properly designed, is more easily operated than the sliding type, is less frequently clogged by chips and dirt, and also lends itself more readily to a compact design of the jig; furthermore it costs somewhat less to make. However, unless the pin on which the vee swings is correctly located with respect to the surfaces of the vee the ordinary variation in size of the castings to be held in the jig may affect the accuracy of location. The trouble is due to the effective center of the vee swinging across the center line of the jig, instead of approximately in line with it. Because of the uncertainty regarding the positioning of the swing pin, the swing vee has been used infrequently. It is the purpose of this article to present a simple method for correctly locating the swing pin.

Referring to Fig. 1, *A* shows a swing vee incorrectly designed. The effective center *C* of the vee cuts across the center line of the jig at a decided angle, resulting in inaccurate locating whenever the castings vary in size, as indicated by the dotted lines. At *B* this fault has been overcome by mov-

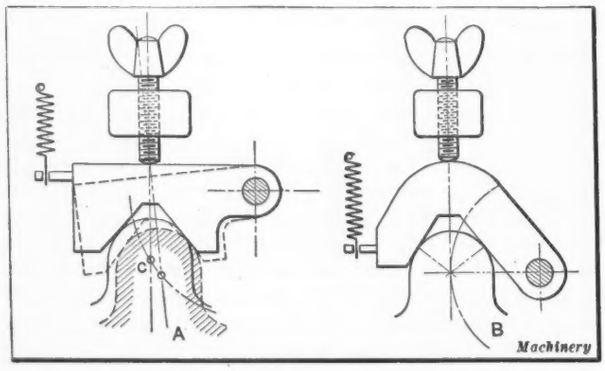


Fig. 1. Correct and Incorrect Locations of Swing Pin

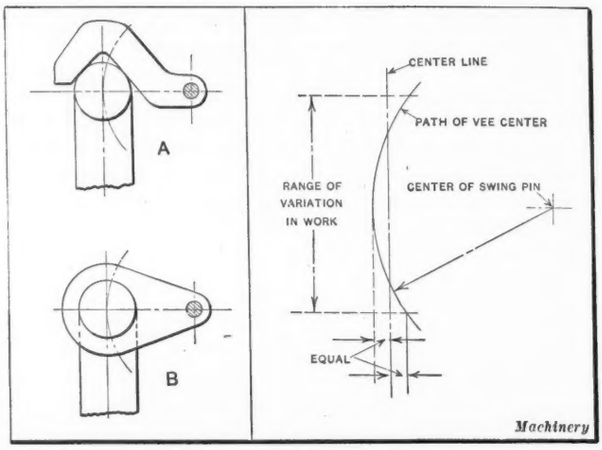


Fig. 2. Comparison between Swing Vee and Arm

Fig. 3. Diagram showing Slight Inaccuracy caused when Work is Variable

ing the swing pin to a point in line with the effective center of the vee when in its normal position. The variation in the work will cause but slight variance from the center line, so slight in fact as to require but little consideration. This is due to the very small arc which the effective center of the vee would describe in the case of an average amount of variation in the work. For instance, when the distance from the center of the vee to the swing pin is 3 inches and the variation in the work is ¼ inch the maximum inaccuracy

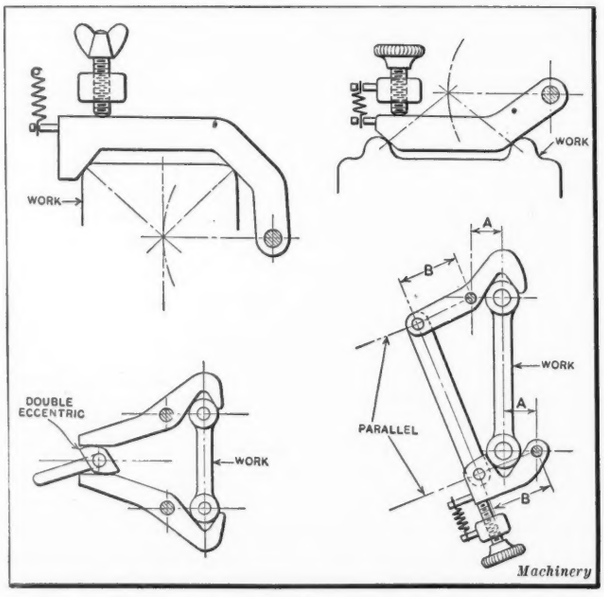


Fig. 4. Examples showing Proper Method of locating Centers for Swing Pins

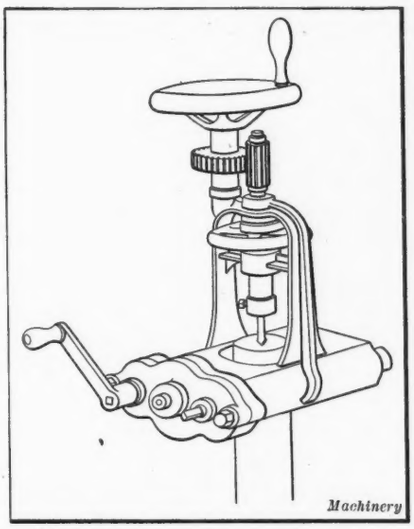
sidewise will be less than 0.002 inch, provided the vee has been located so that the error has been equally divided, as shown in the diagram Fig. 3. The two pieces shown in Fig. 2 demonstrate plainly and simply the correctness of the method prescribed. It is evident that the swing vee at *A* is practically equivalent to the arm at *B*.

In the upper part of Fig. 4 are shown the correct designs for two special cases. The same principle for positioning the swing pin holds good in all cases. The effective center of the vee is at the intersection of lines drawn perpendicular to the vee surfaces at the points of contact with the work. The lower part of Fig. 4 illustrates two forms of double-end equalizing devices employing swing vees. They are well suited for locating links and similar work in drill jigs.

Chicago, Ill. ROBERT SPURGIN, JR.

SMALL PORTABLE CENTERING MACHINE

The use of the small portable centering machine shown in the accompanying illustration eliminates the necessity of



Small Portable Centering Machine

lifting heavy shafts into a lathe for the purpose of centering. The machine grips the shaft by a V-chuck operated by a detachable crank-wrench. The drill spindle is driven by gears which are actuated by the large handwheel. A smaller handwheel, which is threaded on the spindle bushing, serves to feed the drill to the work.

A. J. CAHEN
Brooklyn, N. Y.

METHOD OF MEASURING TUBING

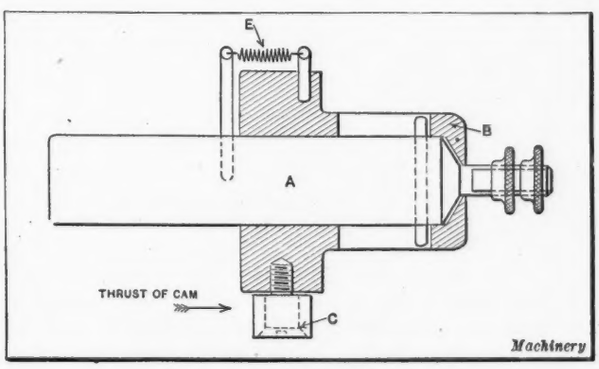
On page 255 of the November number of MACHINERY, Howard M. Nichols describes a method of measuring tubing with a steel ball and micrometer. Having found this method rather difficult, the writer devised the following scheme. A piece of brass tubing, having the inside diameter equal to the outside diameter of the anvil of the micrometer, was soldered to a steel ball. The end of the tubing was then trimmed so that it would not touch the frame of the micrometer when the face of the steel ball on the inside of the tubing came in contact with the anvil of the micrometer. The tube was then slipped over the anvil of the micrometer and thus held the ball in position while measuring the thickness of the tubing. This eliminated the necessity for setting the ball after taking each measurement.

Aurora, Ill. J. J. BORKENHAGEN

SUPPORTING TOOL WITH STRIPPER FOR AUTOMATIC SCREW MACHINES

A tool similar to the supporting tool described in the September number of MACHINERY is shown in the illustration; it is used for handling work on an automatic screw machine, after it has been cut off with a double cutting-off tool. The tool consists of a body *A* with a pilot for supporting and keeping the pieces in alignment so that they will not become lodged between the blades of the cutting-off tool. With the revolving of the turret to any succeeding position, roller *C* is brought into contact with a cam, which forces stripper *B* forward, depositing the work from the pilot into a box, free from oil and chips. The cam is placed on the slide of the screw machine and is set up similar to the closing device of an adjustable die-head. As soon as the stripper operates, it is brought back into position again by the action of spring *E*.

Chicago, Ill. A. WYZENBEEK



Supporting Tool with Stripping Device

WOMEN IN THE MACHINE TOOL INDUSTRY[1]

It is assumed that the deliberations of the War Cabinet Committee on Women in Industry are directed toward the framing of recommendations which, being ideal, should bring about the following results in the machine tool industry of Great Britain:

First, the maintenance of the engineering industry in a condition of maximum profitable activity.

Second, the employment in that industry at fair and adequate wages and under healthy and harmonious conditions of the maximum number of men workers.

Third, the employment in that industry on work within their capacity of such numbers of women workers as the demand for additional labor may render necessary and under conditions in which they are protected from unduly low wages and from possible injury to their health.

Women have never been employed and cannot be employed in the machine tool industry to the extent that they are in other industries, such as the sewing machine trade, the manufacture of small arms, the manufacture of electrical fittings, the production of shells, and the details of airplane work, because all of these industries, dealing as they do with immense quantities, afford much greater scope for women's work. There has been a great deal of discussion about the possibility of women being able to take the place of skilled mechanics, but in the consideration of this problem it is well to face the facts. Owing to fundamental differences in mentality, it is certain that only in exceptional instances can women become skilled mechanics. It is difficult, of course, to give an actual definition of what a skilled mechanic is, but it is well to remember that an apprenticeship of a considerable number of years, varying from five to seven, is found by experience to be necessary to produce a skilled workman.

Briefly, a skilled workman is a man capable of undertaking any job in his branch of the trade, able to work to drawings, to prepare his tools, to set up his machine, and to turn out a satisfactory job from start to finish. While some women may be found who are capable of doing this, it has not been the writer's good fortune to encounter them. On the other hand, a woman is quick to learn any particular job. She is intelligent, obedient, and generally a good worker and when she has become familiar with the details of a definite operation she will continue to repeat that operation satisfactorily and in many cases will produce as large an amount of work as a man. Moreover, she is by disposition better adapted than a man to the performance of a repetition job without becoming weary of the work.

The future of women, therefore, in connection not only with the machine tool trade, but with mechanical industry generally, is to accept work which is capable of being produced in quantities with the use of such machinery and appliances as reduce the work largely to a matter of routine, and in this direction there is a great possibility for her work. She will relieve the male worker from the drudgery of routine to a large extent and will give him fuller scope for development in the higher branches of his trade.

Women's wages before the war were invariably much lower than men's, but as their employment has developed there has been a constant tendency toward increasing their rate of pay, which at present in mechanical industry is in most instances in excess of their economic value. Regarding the rates of wages to be paid to women, it will be admitted that the present rates are artificial and not economic, that they have been rendered possible only by the fact that war conditions are artificial and not economic, and that now with the coming of peace these artificial conditions will very largely be swept away, and industry can prosper only to the extent that the conditions under which it is carried on are normal.

[1]Abstract of a paper prepared by Sir Alfred Herbert, of Alfred Herbert, Ltd., Coventry, England, chairman of the Machine Tool and Engineering Association of Great Britain, and submitted to the War Cabinet Committee on Women in Industry.

THE FUTURE OF THE MACHINE TOOL TRADE IN GREAT BRITAIN

In order to obtain an authoritative opinion relating to the future of the machine tool business in Great Britain, a circular letter was addressed to the leading manufacturers and dealers of machine tools in England and Scotland, in which a number of definite questions were asked, the replies to which have been digested in the following paragraphs, so as to give a comprehensive idea of the opinions of the leaders in the British machine tool business. The questions asked related to the following subjects: (1) The general future conditions of the trade; (2) export trade; (3) effect of second-hand tools that may be placed on the market; (4) the creation of new demands for machine tools by a combination of improved design and lower production costs; (5) the future of women in the machine tool industry; (6) the increase of the British machine tool industry as a result of the war; (7) the effect on the trade of the re-equipping of the shops of many firms during the war.

General Outlook of British Machine Tool Trade

The consensus of opinion is that the general outlook in the machine tool trade is promising. Several firms state that, judging by inquiries and orders, there will be a keen demand for good grades of machine tools for a considerable time to come. It is pointed out that it will be necessary for the British machine tool builder to adopt modern methods of advertising and selling and to keep his designs up-to-date; it is also emphasized that manufacturers whose machines are not of a first-class standard may expect difficulties in disposing of their product.

Export Trade for British Machine Tools

The belief is that there will be a large demand for machine tools all over the world for a considerable time to come, and that the foreign trade should prove satisfactory. It is recognized that the competition with America will be keen and that it is necessary to make prompt deliveries. Some firms look especially for a good export trade in the heavier types of machine tools. The necessity for the proper kind of advertising, traveling and attention to details in the design of machines is emphasized.

Effect of Second-hand Machines on the Trade

The general opinion seems to be that a large number of second-hand machines will be placed on the market and that these machines will affect the trade in new machines for some time to come. One machine tool builder mentions that he has himself 100 second-hand turret lathes to offer. The opinions differ, however, somewhat on this subject. While there is a general agreement as to the fact that there will be many second-hand machines offered, particularly in the smaller sizes, such as small lathes which have been used on shell work, etc., it is admitted that many of these tools will be very badly damaged, and while they may be repaired, they would not directly compete with first-class machine tools. It is believed that there will not be many of the heavier types of machine tools on the second-hand market, as this class of machinery has not been produced in large quantities during the war. One manufacturer believes that the second-hand machines will be easily absorbed, principally by smaller firms who are just starting in business and who may be unable to pay the present high prices for new machines. It is also suggested that the major portion of the older machines should be scrapped because of inefficiency.

Creating a New Demand by Improved Designs

The high cost of labor and high taxes will necessitate the keeping of manufacturing plants at the highest degree of efficiency in order to obtain a maximum output, hence the machine tool builder who can offer improved designs which will increase production has a distinct advantage over his competitors. It is well recognized that the final stages of increase in production by improved machinery have not yet been reached. There will be a necessity for greater specialization on certain classes of machine tools, and fewer models will also have to be built of a given line of machines, so that in this way the machines can be manufactured more economically than formerly. This, in turn, will permit of a lower selling price that would stimulate the trade. One dealer points out that improved designs and increased productive capacity of machines will create new demands where purchasers appreciate the value of the improvements, but he regrets to state that, in the past, manufacturing concerns in England, generally speaking, were not as quick to grasp the value of improvements in machine tools as were similar concerns in other countries.

Future of Women in the Machine Tool Industry

The general opinion of machine tool builders in England seems to be that women are not suitable for employment in the machine tool industry, as they are not adapted to the operation of heavy machine tools and are employed to advantage only on repetition work. Some manufacturers express very definite opinions as to the unsuitability of women in this trade. There are exceptions to this, however, and in one reply it is pointed out that women have been employed for years before the war at occupations far more laborious and unpleasant than those in the machine tool industry; but even in this reply it is admitted that they are likely to be employed on repetition work only.

Increase in the British Machine Tool Output

It is believed that the British machine tool output has been approximately doubled during the war period. This has been accomplished by more intensive production in the works of the machine tool builders and also by adapting shops making other classes of machinery, such as textile machines, printing presses, etc., to machine tool building. It is believed by most of the manufacturers and dealers that the output from the regular machine tool building plants can be maintained in the future. It is pointed out that railroad shops, locomotive plants, and a number of other machine building works have placed no orders for machine tools for several years, and when these large industries begin to order machine tools, the demand will easily absorb the increased capacity of the present plants. The demand expected from Belgium, France and, later, from Russia will also prove an important factor.

Effect of New Equipment Secured During the War

While it is true that a great many factories in England have equipped their shops with new machinery during the war, it is not believed that this will act as a detriment to the machine tool trade. Many of these machines have been subjected to unusually hard wear during the past years, having been running night and day with a minimum amount of adjustment and repairs. Furthermore, there has been a great development in the machinery trades in Great Britain generally, and many new firms will require a considerable number of machine tools. There will also be a great inducement to manufacturers to install modern machinery whenever greater efficiency can be proved, and, hence, after the war, the plants will be kept more up-to-date than they have been in the past. It will be much easier for machine tool makers to convince buyers and users of machine tools that it is uneconomical to run antiquated machines and that the better results obtained from modern equipment will shortly repay for the additional outlay. While many British firms have already replaced some of their older machines with new equipment, there are thousands of the older machines that have been put to such hard usage during the war that they will be immediately consigned to the scrap heap.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

IN THIS NUMBER

Blomquist-Eck Horizontal Boring Mill. Blomquist-Eck Machine Co., 1146 E. 152nd St., Cleveland, Ohio..... 465
Universal Relieving Machine for Hobs and Cutters. T. C. M. Mfg. Co., Harrison, N. J..... 467
Oliver Motor Drive for Double-spindle Shaper. Oliver Machinery Co., Grand Rapids, Mich..... 468
Winfield Electric Butt Welder. Winfield Electric Welding Machine Co., Warren, Ohio..... 469
Garrison Bevel Gear Chuck. Garrison Machine Works, Dayton, Ohio..... 469
Alemite Lubricating System. Alemite Metals Co., 341-351 W. Chicago Ave., Chicago, Ill..... 470
Gray's Sheet Metal Cutter. W. J. Savage Co., Inc., Knoxville, Tenn..... 470
Noble and Westbrook Graduating and Marking Machine. Noble & Westbrook Mfg. Co., Hartford, Conn..... 471
Barrett-Cravens Lift Trucks. Barrett-Cravens Co., 713 Transportation Bldg., Chicago, Ill..... 471
Hagman Safety Clutch. Hagman Machine Works, Solar and West Division Sts., Syracuse, N. Y..... 472
Newton Upright Generating Planer. Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa..... 473
Hoskins Multiple Recording Pyrometer. Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich..... 474
Cone Automatic Magazine Attachment. Cone Automatic Machine Co., Inc., Windsor, Vt..... 474
Taylor-Shantz Inclinable Power Press. Taylor-Shantz Co., Rochester, N. Y..... 475
Seaboldt Thread Inspecting Apparatus. B. Seaboldt Corporation, 25 West Broadway, New York City..... 475
Production Surface Milling Cutters. Production Tool Co. of America, Detroit, Mich..... 475
Bemis Collet Lathe Chuck. E. W. Bemis Machine Co., 92 West St., Worcester, Mass..... 476
Black & Decker Portable Electric Drill. Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md..... 476
Skelton Burring Fixture. Skelton Sales Co., Syracuse, N. Y..... 476
Titan Pneumatic Hammer. Titan Automatic Tool Co., 25 W. Broadway, New York City..... 477
Landau Back-geared Tapping Attachment. Landau Machine & Drill Press Co., Inc., 19 W. 44th St., New York City.... 480

BLOMQUIST-ECK HORIZONTAL BORING MILL

IN Figs. 1 and 2 there are shown front and rear views of a No. 1 horizontal boring, drilling and milling machine which has recently been placed on the market by the Blomquist-Eck Machine Co., 1146 E. 152nd St., Cleveland, Ohio. The working efficiency of a machine of this type depends upon its ability to operate upon all classes of work at the highest speeds and coarsest feeds that are practicable, and to produce a finished product of dependable accuracy. It is claimed that these points have been developed to a high degree by combining rigidity, accuracy, and a suitable range of selective speeds and feeds with carefully selected materials used in making all parts of the machine. A complete system of jigs, fixtures, and gages are used, insuring a uniform standard construction throughout as well as the interchangeability of parts. The various groups of mechanism form complete individual units and any unit can be inspected, removed, and put back again without disturbing the alignment or any adjoining unit. The following description is devoted solely to the most essential features of construction.

In working out the design of this machine special provision has been made for operating it under severe conditions of service. The base is made solid directly below the column and braced with cross-ribs at other points, thus affording ample rigidity. Provision is made for operating under the highest speeds and coarsest feeds which high-speed steel tools are capable of standing. The machine is constructed on the unit principle so that various parts of the mechanism may be removed intact without disturbing other members. A complete system of jigs and fixtures is used in manufacturing all parts, insuring a uniform standard construction and interchangeability of parts.

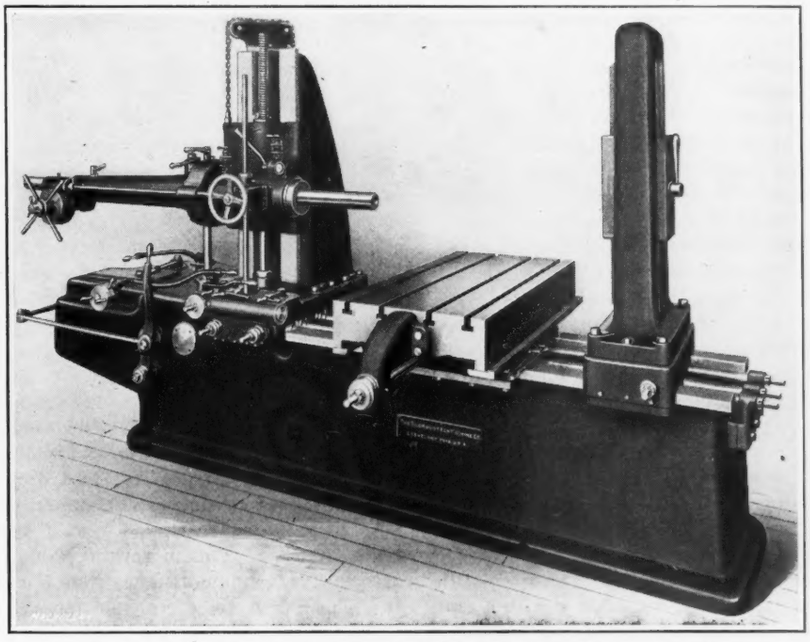


Fig. 1. Front View of No. 1 Boring, Drilling and Milling Machine built by the Blomquist-Eck Machine Co.

The bed or base is a wide and deep box section casting which is made entirely in one piece. The outer walls directly under the column are left without cored openings, which adds greatly in resisting the stress at this point. Chip chutes are provided, and these are so arranged that their walls give added strength. Directly under the column the bed is reinforced by sections tied together and cast integral with the base. The bed is further reinforced by heavy, deep ribs running lengthwise and at right angles; and a three-point support or bearing is used, which is believed to form the best-known foundation principle. The column is also of the box-section type of design, strongly braced internally by ribs in both horizontal and vertical positions. The tapered sides and base of the column give the machine a substantial appearance, and also provide a liberal bearing upon the bed, eliminating deflection and spring.

The spindle saddle is designed with a liberal bearing surface on the face of the column and a long, narrow guiding edge, with a single screw-operated taper gib for making adjustments on one side and a square lock form with a gib on the other side. This construction will always maintain and insure a perfect alignment for the spindle saddle. The center of the spindle in the spindle saddle is placed as close to the column face as pos-

sible, reducing overhang to a minimum without sacrificing strength at this important point. The elevating screw, which is between the column faces and the spindle, is placed in such a position in relation to the narrow guide that the vertical movement of the saddle is direct and accurate. The units comprising the spindle and saddle are counterbalanced by a weight within the column, thus relieving the elevating screw of wear and tension. High-carbon steel is used in making the spindle, which is heat-treated, ground over its entire length, bored Morse taper and provided with an end thrust bearing capable of operating in either direction. The spindle sleeve consists of a special hammered high-carbon steel forging accurately ground inside and out, thereby insuring a perfectly uniform spindle bearing. The front and rear spindle-sleeve bearings are adjustable and tapered, these bearings being made of bronze. Either bearing can be adjusted to compensate for wear, and sight-feed oil-cups provide for adequate lubrication of the bearings.

Provision is made for the boring-bar support to be raised or lowered in unison with the spindle saddle by a shaft and a set of planed steel bevel gears. The bar support or bearing proper, may be securely clamped by a lever binding bolt in any position. In working out the design of the spindle, provision has been made for handling either the heaviest or finest class of work. The close-coupled driving gear shafts, mounted on S K F double-row self-aligning ball bearings, transmit power to the spindle in as direct a manner as possible. All shafts are made of high-carbon steel, and heat-treated steel ring spur gears are used wherever possible, these gears being shrunk onto cast-iron hubs. The smaller spur gears in the drive are made of solid steel and heat-treated, while the bevel gears are made of hammered steel forgings planed from solid blanks. Speed changes are made by two levers at the front of the machine, which operate the selective sliding gears, and care has been taken to locate properly the entire driving mechanism and each individual shaft and bearing so that it can be removed or replaced without disturbing any adjoining unit. Access to the entire unit may be had through an oil-tight top plate cover, the removal of which permits of an easy inspection when required. All gears run in a bath of oil, and in addition a positive cascade oiling system is provided for both gears and bearings.

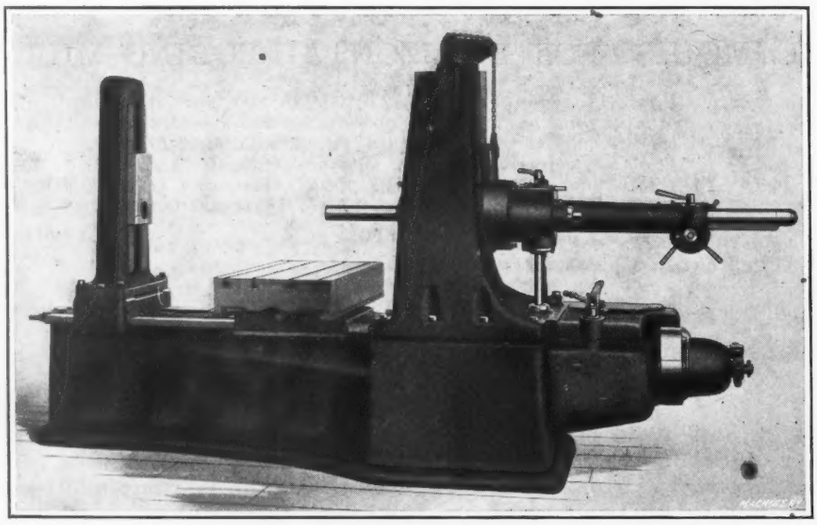


Fig. 2. Opposite Side of the Blomquist-Eck Boring, Drilling, and Milling Machine

In working out the design of the feed mechanism, provision has been made to have the feed movement to the spindle in either direction, to the spindle saddle in raising or lowering upon the column, to the table saddle moving parallel to the bed, or to the table moving longitudinally upon its saddle actuated or controlled by the same direct positive geared mechanism that is effectively applied to the spindle drive. All of the shafts are made of high-carbon steel mounted on S K F ball bearings, and all gears are made of steel and heat-treated. The feed mechanism in the base is arranged so that any unit may be removed or replaced without disturbing any adjoining unit. All gears run in a bath of oil and an additional positive cascade oiling system is provided for bearings and shafts, as in the case of the speed unit. The feed changes are made by two levers which are placed directly in front and at the top of the gear-box. In addition, three selective interlocking levers are provided, that engage either the spindle, vertical, or table feeds. If the spindle feed is being operated, the table and vertical feeds are automatically locked, or vice versa. No two conflicting feeds can be engaged at the same time. In operating star-feed facing heads or work of similar nature, all feed-levers can be positively locked in a neutral position. Convenience and safety are provided for the operator by placing all controlling levers to the front of the machine and high enough so that he has no occasion to stoop to reach them beyond his normal working position.

The bed surfaces have been designed in a way that enables the use of a long saddle, in order to compensate for any overhang of the table at the extreme front or rear positions. When the table is in either extreme position, it is supported in the saddle for practically three-fourths of its entire length. The saddle is gibbed to the bed by the square-lock method, having a long, narrow guiding edge with a taper gib for adjustment. Perfect alignment is said to be always assured. The table is made long, wide, and deep. It is reinforced by heavy ribs, and the metal has been carefully distributed to resist the greatest strain that might be imposed. The T-slots are planed from the solid metal and the table is securely gibbed by the square-lock method, which in this instance reinforces and resists strains when the table overhangs the saddle.

Power rapid traverse of a friction type is provided for all members operated by the feed, and regardless of whatever feed may be engaged the rapid traverse always operates at one rate of speed in either direction. It is instantly engaged or disengaged without disturbing the original feed setting. An adjustable safety friction leather washer in the clutch mechanism prevents damaging any portion of the mechanism engaged, and the clutch control is sensitive and practically any amount of travel can be obtained. The table saddle or table adjustments are provided in addition to the automatic feeds. All screws are fitted with graduated dials reading to 0.001 inch. A spindle friction clutch pulley drive operating at constant speed is regularly furnished, and a constant-speed or adjustable-speed motor drive is furnished when required at extra cost.

The principal dimensions of this machine are as follows: Diameter of spindle, 3⅛ inches; travel of spindle, 30 inches; taper bore of spindle, No. 5 Morse; number of spindle speed changes, 12; range of spindle speeds in revolutions per minute, 16 to 196; number of feed changes to spindle or table, 9; number of feed changes to spindle or table with back-gears, 18; ranges of feed in inches per revolution of the spindle, 0.003 inch to 0.518 inch; working surface of table, 24 by 54 inches; automatic longitudinal feed to table, 36 inches; automatic transverse feed or parallel movement of table with bed, 37 inches; maximum distance from spindle nose to outboard bearing, 5 feet, 5 inches; maximum distance from top of plain-working table to center of spindle, 27 inches; maximum distance from top of bed to top of table, 10 inches; diameter of constant speed friction drive pulley, 14 inches; width of driving belt, 4 inches; speed of friction driving pulley in revolutions per minute, 350; weight of machine crated for domestic shipment, approximately 11,600 pounds; weight of each extra length of bed, 1000 pounds; and size of motor recommended, 5 horsepower.

UNIVERSAL RELIEVING MACHINE FOR HOBS AND CUTTERS

The greatly increased use of worm-gearing in motor trucks, tractors, and power farm machinery, has created a demand for hobs suitable for the production of such worm-wheels accurately and quickly. The principal problem in the production of a hob is in properly relieving the cutting teeth.

The machine illustrated in Figs. 1 and 2, built by the T. C. M. Mfg. Co. of Harrison, N. J., is especially adapted for relieving hobs of any design as well as any type of formed cutter. In addition, the machine could be used for many classes of work ordinarily performed on an engine lathe of standard design, although such a practice would not be advisable, as the various refinements that are required on this hob-relieving machine make its cost much higher than that of a lathe.

This machine is especially suitable for relieving the particular form of hob which has been found most suitable for the cutting of heavy worm-gears complete at one pass of the hob. Such a hob is tapered at one end, and the threads on this tapered section have a gradually increasing lead, although the lead of the threads on the cylindrical section of the hob are of uniform lead.

Evidently the problem of relieving the teeth of a hob of this special form is considerably complicated by the tapered section on which there is a thread of variable lead; the problem is further complicated by the fact that the gashes in the hob are cut at an unusually steep angle. The relieving operation is divided into three steps, the first of which is to start at the small end of the tapered section and relieve one side of the teeth on the taper; next, gears are changed and the relieving operation is continued by relieving the other side of the teeth on the taper; and at this point, the swivel base on which the relieving attachment is carried must be set around to provide for working along the straight or cylindrical portion of the hob. The reason for changing gears when relieving opposite sides of the teeth on the taper is that, owing to the increasing lead of the thread on this portion of the hob, a start must be made with change-gears which are suitable for a number of threads per inch which is *less* than the number the work actually has. After relieving one side of the teeth on the taper the gears are changed to give a setting corresponding to a number of threads per inch which is *greater* than the actual number per inch. The result is that the relieving operation is started with an arrangement of gearing which retards the movement of the tool to compensate for the gradual thickening of the thread, due to its increased lead, while the remainder of the relieving on the tapered portion of the hob is performed with gearing which provides for doing the work with an accelerated movement of the tool that also takes care of the thickening of the thread.

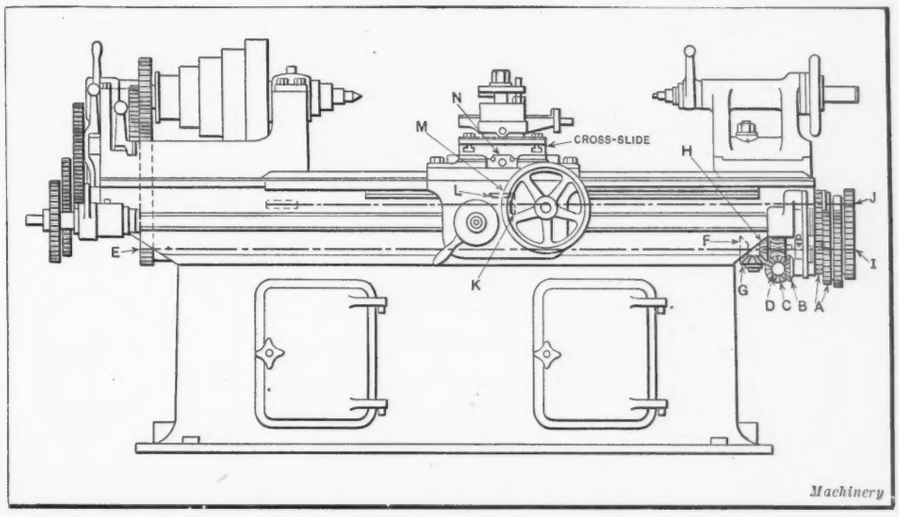


Fig. 2. View of Machine illustrated in Fig. 1, showing Details of the Mechanism

Reference has also been made to the necessity of providing for the effect of the steep angle of the gashes, and this is done by employing an arrangement of differential gearing to govern the timing of successive strokes of the relieving attachment. When relieving t e teeth of ordinary hobs and similar work with gashes parallel to the axis, it is merely necessary to time the strokes of the attachment so that the tool comes into engagement with successive teeth. But with a hob having spiral gashes with the spiral cut at a steep angle, it will be apparent that the uniform timing for the relieving attachment could not be employed. It is necessary to so regulate the rotation of the work and the oscillating movement of the relieving attachment that the necessary correction will be made for the effect of the angular gashes. The way in which this result has been worked out on the Thomson relieving machine will be described in detail in a subsequent paragraph.

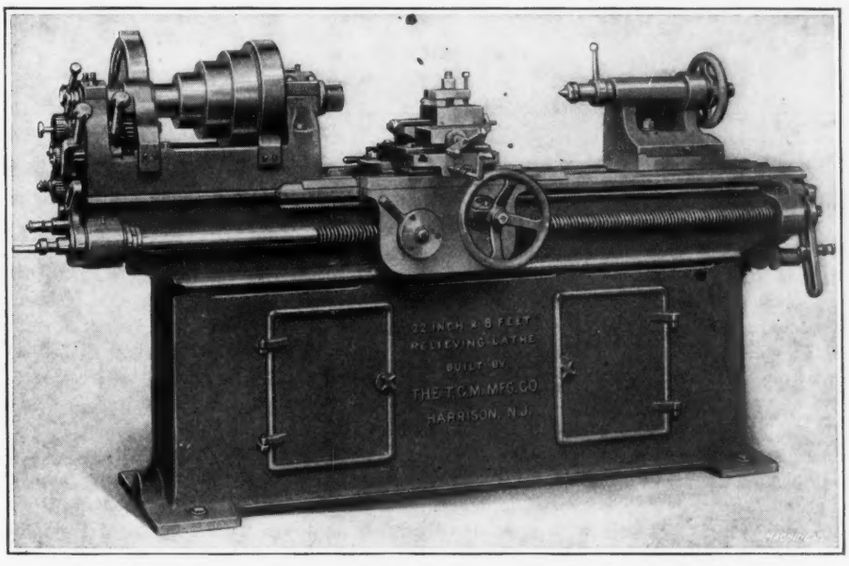


Fig. 1. Machine for relieving Hobs, Milling Cutters, etc., which is built by the T. C. M. Mfg. Co.

General Description of the Machine

It will be apparent from Figs. 1 and 2 that in its general appearance this machine is similar to a standard engine lathe, the work being carried between centers and the relieving attachment supported on a carriage of somewhat the usual design. After studying the illustrations in connection with the following description it will be obvious, however, that this machine is provided with a number of interesting features of design which will make it of rather exceptional interest to machine-tool designers. Probably there is no better means of explaining the method of operation than to present

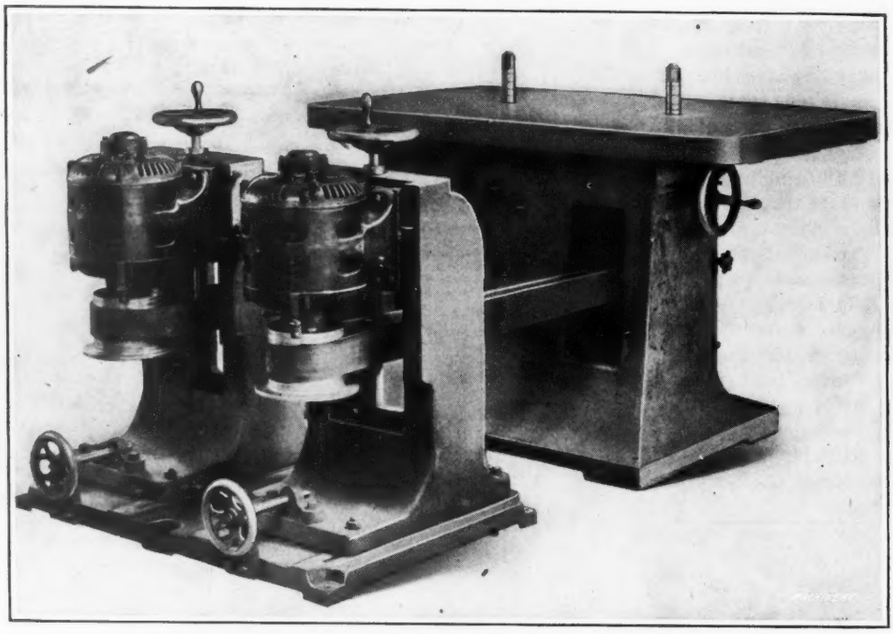
a description of the way in which power is transmitted through the various mechanisms from the cone pulley on the headstock. When the machine is used for relieving hobs, it is almost universally the practice to drive the spindle through the back-gears, but, owing to the coarse lead of the hob threads, it is required to have a considerable difference in the speed of rotation between the lead-screw and the spindle. This result could be obtained through an ordinary train of gears, but in order to simplify the design it was decided to provide two gears, one secured to the spindle and the other to the cone pulley with a clutch between the two, so that either the spindle gear or the cone gear could be employed for driving. The clutch is controlled by a push-rod at the end of which there is a small knob which will be seen opposite the upper gear at the left-hand end of the machine in Fig. 1. The initial speed depends upon whether the spindle gear or cone pulley gear is engaged by the clutch, but, regardless of this selection, power is transmitted to gears carried by a horizontal shaft located under the headstock and thence through change-gears at the left-hand end of the machine to the lead-screw. The change-gears may be adjusted in the usual way to provide for relieving the teeth of hobs of any given number of threads per inch.

Located at the right-hand end of the lead-screw it will be seen that there is a train of gears *A*, Fig. 2, which transmit motion from the screw through a pair of bevel gears *B* and *C* to a worm-shaft *D* that drives a worm-wheel. This wheel is the outer member of a differential which regulates the timing of the relieving attachment to compensate for the spiral angle of the gashes in the manner to which reference has already been made. Power is transmitted to the other side of the differential gear through a train of spur gears, located at the left-hand end of the machine, which drive shaft *E*. At the right-hand end of this shaft there will be seen three bevel gears, *F*, *G*, and *H*, the last of which is inside the differential. Bevel gear *H* is carried at the left-hand end of shaft *I*, which is in line with shaft *E*. From shaft *I* power is transmitted through spur gears to a horizontal shaft *J*, carried by bearings inside the bed of the machine, and through this shaft the drive is through bevel gears *K* and *L* to a vertical shaft *M*, on the upper end of which there is a cam *N* that fits into a cam box in the cross-slide on which the relieving tool is carried. By adjusting the change-gears on shafts *I* and *J*, the required number of strokes may be obtained for the relieving tool, while adjustment to compensate for the spiral angle of the gashes is effected by the differential movement.

In Fig. 1 it will be seen that there is a small crank handle midway between the crank on the cross-slide and the handwheel on the apron. The purpose of this crank is to provide for releasing the compression of two springs which hold the cross-slide in contact with the cam *N* that provides the oscillating movement to the relieving attachment. By simply operating this master control lever, the oscillating movement is stopped while the carriage is being run back to the starting point or while other similar adjustments of the machine are being made. Independent adjustment of the tension of each of these springs is furnished by means of two screws which will be seen at each side of the master control lever. Another valuable feature of the design is the provision of means for locking the differential movement, in order to adapt the machine for relieving hobs with straight gashes or for relieving milling cutters and other similar work. In this connection, attention is called to the fact that the relieving attachment is supported on a swivel saddle so that the tool may be set at any required angle with the work. This adjustment covers a range of 180 degrees, thus enabling the machine to be employed for any work coming within the extremes of relieving straight gashed hobs or milling cutters up to the relieving of the side teeth on face mills.

OLIVER MOTOR DRIVE FOR DOUBLE-SPINDLE SHAPER

The Oliver Machinery Co., Grand Rapids, Mich., is now building a compact type of motor drive for use on double-spindle shapers. Standard vertical-spindle electric motors are used in connection with this drive. As shown in the accompanying illustration, a separate motor is employed for driving each spindle, each motor being mounted on vertical gibbed ways which are adjustable by means of a handwheel and screw so that the motor can be located at any desired height. A scale is provided to facilitate making these settings to meet the requirements of the work. Each motor stand is also independently adjustable to and from the shaper spindle to suit the length of belt and to afford means of taking up the stretch of the belt, thus avoiding the necessity of using belt tighteners or similar devices. Where this equipment is employed, every shaper spindle can be controlled independently by merely throwing the proper switch for the motor operating that spindle. An economy of floor space is effected through the use of this motor drive, a distance of only 5 feet between centers being required, making the actual floor space occupied by the machine about 7 by 5 feet. Also, standard vertical-spindle motors of the kind called for by the electric current available in the factory may be employed, thus doing away with the need of using highly specialized built-in motors. This form of drive may be furnished on new machines, or for shapers which are now in use, and any kind of starting units can be furnished.



Double-spindle Shaper with Improved Motor Drive built by the Oliver Machinery Co.

CORRECTION

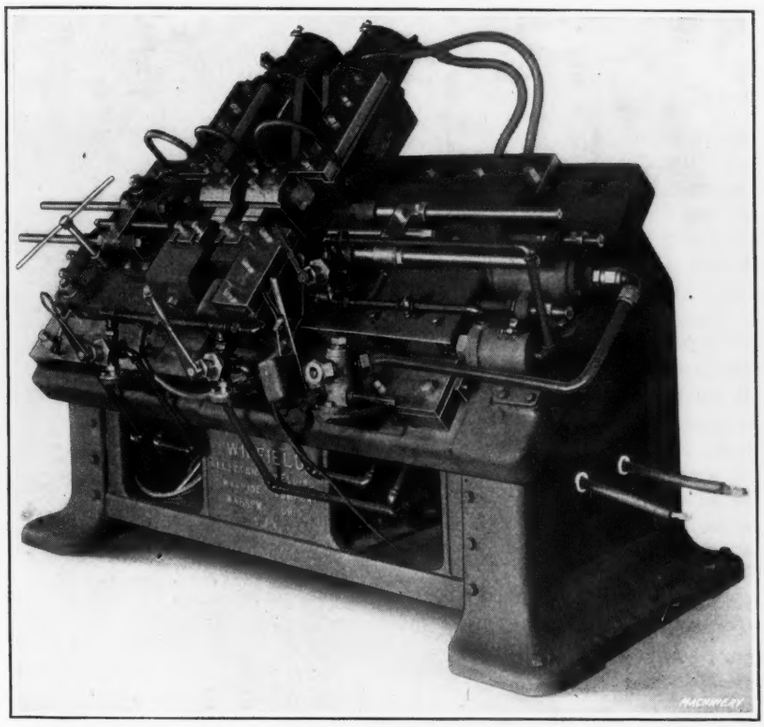
The welding compound known as "Tip-It" referred to in the New Machinery and Tools Section of the December number of MACHINERY, is manufactured by a firm called "Tip-It," located at 120 Broadway, New York City, instead of by the Haynes Stellite Co., Kokomo, Ind., as was stated.

WINFIELD ELECTRIC BUTT WELDER

The Winfield Electric Welding Machine Co., Warren, Ohio, is now building a Type B-13 electric butt welding machine which is here illustrated and described. This particular type of machine has been found very satisfactory for welding high-speed tool steel and similar work in machine shops and other industrial plants where tools of large diameters are handled. Tools for lathes, planers, shapers, etc., are handled quickly and satisfactorily by this method; and drills, reamers, broaches and similar tools may be treated in the same manner. When welding any of the high-speed steels to low carbon stock, a simple annealing operation is necessary in order to reduce any strain between the two steels of different analysis. If this were not done, the material would check at the weld and the natural conclusion then would be that the weld itself was defective. It is stated that this is not the case and that the proper heat-treatment of the tool or other work so welded eliminates all trouble of this kind.

The welding machine itself is of extremely heavy construction, careful attention being paid to obtaining extreme rigidity so that no variation in the work is present after the welding operation has been completed. Pressure for clamping the material is provided for by means of compressed air cylinders. The upsetting slide on the right-hand end of the machine is moved by means of a compressed air cylinder in order that the work can be kept in close contact while being heated, and the final pressure for upsetting the weld and holding the two pieces closely together is accomplished by means of a 10-ton hydraulic ram which can be furnished for any available pressure. All clamping and upsetting operations are controlled by means of separate valves, enabling the operator to clamp each piece properly before the welding current is applied. This machine is equipped with the necessary adjustments for accomplishing first-class work, the table to the left being equipped with adjustments for moving up and down, back and forth, tilting or twisting. Adjustments of every kind are provided both for keeping the work in correct alignment and also for regulating the amount of take-up in each weld, so that on production work each and every piece must be of absolutely the same length. The table of the machine is placed at an angle of 45 degrees, which makes the operation very convenient, as the operator is able to stand in an upright position and does not have to bend or stoop over in order to observe the work.

This machine is especially designed for handling work of large cross-sectional area, and it has a capacity for welding round pieces up to and including 2½ inches in diameter. The terminals are cooled by a stream of water which flows from one terminal to the other, and the welding dies are held in place with slotted clamps which permit of their being easily removed. The work is prevented from slipping by means of threaded back-up stops, and adjustments are provided to regulate the amount of upset in each weld. The movable table is fitted with roller bearings to insure easy operation. The equipment furnished with this machine includes a 125 KW Winfield transformer, a ten-step self-contained current regulator, and the current for welding is controlled by a Cutler-Hammer magnetic switch which, in turn, is operated by means of the small auxiliary switch placed on the valve lever controlling the hydraulic ram. The floor space occupied by the electric butt-welding machine described is 60 by 90 inches, and the approximate weight of the machine, crated for shipment, is 8000 pounds.



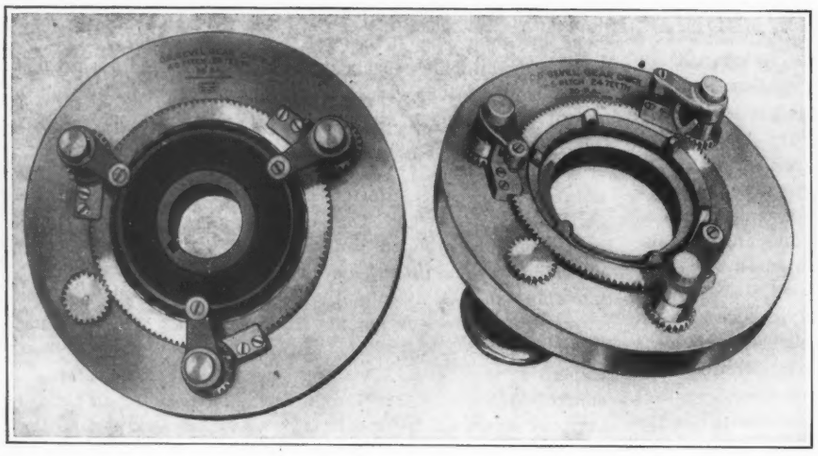
Type B-13 Electric Butt Welding Machine built by the Winfield Electric Welding Machine Co.

GARRISON BEVEL GEAR CHUCK

To provide for the rapid chucking of bevel gears and to assure holding them true with the pitch diameter for grinding or re-machining of the holes or other integral parts of the gear, the Garrison Machine Works, Dayton, Ohio, are now manufacturing the O. G. bevel gear chuck which is here illustrated and described. The actual chucking time for a gear of 6 inches pitch diameter is only five seconds, no measuring, truing up, or indicating being required of the operator. He simply turns a knob on the back of the chuck after inserting the gear in place, and it is automatically located absolutely true and clamped perfectly rigid. With this chuck an unskilled operator is able to work far more rapidly than the most experienced man could do if he had to depend upon training and experience to enable him to set the work true.

In chucking a gear, the clamps are all turned simultaneously into radial positions over the gear and clamped by turning a knob to the right. To release the gear from the chuck, the knob is turned to the left, and this automatically loosens all of the clamps, turning them out of the way of the gear and raising and holding the clamps until another gear is inserted. Then merely turning the knob to the left will automatically return the clamps to their radial positions over the gear and provide for securing the gear in exactly the required position.

The clamps are raised or lowered from or to the clamping position, and also turned away from the clamping position by means of cams located on the lower side of the clamps and on the upper side of the pinion shown beneath each clamp. It is simply necessary to turn the knob one-half revolution in order to manipulate the clamps. In addition to these bevel gear chucks, chucks are also made for holding spur, helical, or skew bevel gears and pinions. Not only does the rapidity and simplicity of operation of these chucks enable inexperienced operators to turn out a satisfactory volume of work, but the automatic locating feature guards against gears being spoiled through having inexperienced men start machining before they have been properly located. The placing of unequal pressure on any clamp is avoided because all of the clamps are automatically operated and brought down on the gear with a very light coil spring which is located inside the hollow stud on which the clamp is mounted. The rear or outer end of the clamp is brought down over the stud by a spring inside of the stud until the

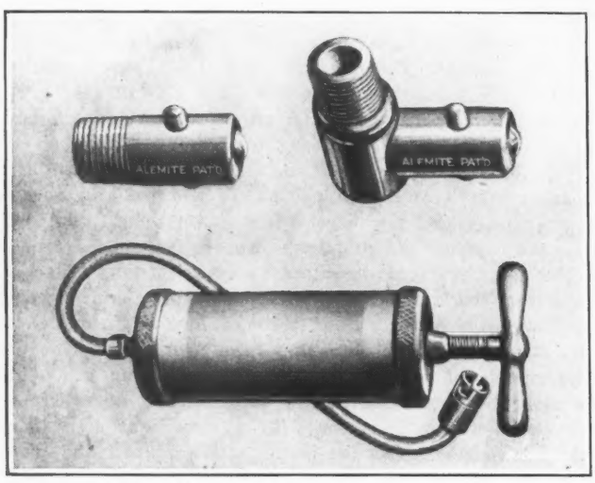


Garrison Bevel Gear Chuck

point or inner end contacts with the gear. As the clamps are free on the studs, they cannot be raised by pressure applied at the inner end of the clamp on account of a cocking action of the clamp on the stud.

ALEMITE LUBRICATING SYSTEM

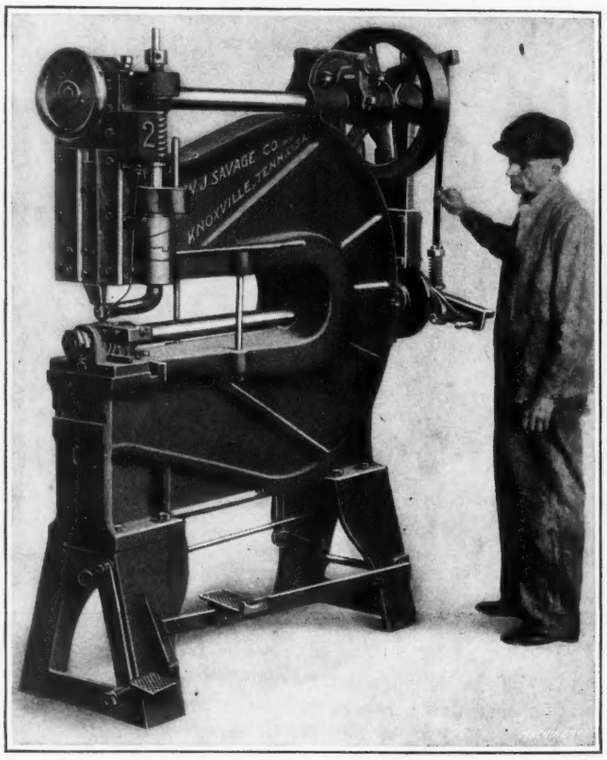
To provide for the efficient lubrication of bearings in which grease is employed as a lubricant, the Alemite Metals Co., 341-351 W. Chicago Ave., Chicago, Ill., is now manufacturing a lubricating system which is shown in the accompanying illustration. The outfit consists essentially of a cylinder made of 16-gage steel, which is knurled to prevent it from turning in the hand. This cylinder is fitted with a screw-operated piston which provides for forcing the grease contained in the cylinder out through a 15-inch flexible steel hose to the bearing which is to be lubricated. Various forms of straight and elbow nipples, etc., are provided for insertion in the oil-holes in the bearings, and connection is made between these nipples and the flexible steel hose by means of a bayonet coupling. The nipples are furnished with ball check valves so that when connection is made with the cylinder, pressure applied enables the grease to enter the nipple while the valve automatically closes to retain the grease in the bearing and exclude dirt and dust. These ball check valve nipples are made in 5/16-inch, 32 threads; and ⅛-, ¼-, and ⅜-inch, with standard pipe threads. With an outfit of this kind the work of lubricating bearings can be handled with extreme rapidity. The application of this method of lubrication can be advantageously employed on punch presses, lineshaft hangers, and a great variety of other machinery where grease can be used as a lubricant. It is stated that it would hardly pay a shop to install an Alemite lubricating system on a single machine that has only one or two bearings to be lubricated. The chief advantage of this system arises where there are groups of machines or individual machines that have a large number of bearings to be lubricated. In either of these cases the time saved through the use of the lubricating system will pay liberal returns.



Lubricating System manufactured by the Alemite Metals Co.

GRAY'S SHEET METAL CUTTER

Gray's sheet metal cutter, which is manufactured by the W. J. Savage Co., Inc., Knoxville, Tenn., may be used for cutting any shape from sheets or plates, and it is to the sheet and plate shop what the band and jig saws are to the woodworking shop. This machine will cut around sharp curves and acute angles readily, and may be applied to such work as the cutting of templets, jigs, gear covers, liners, gaskets, automobile and airplane parts, various shapes required in ship construction and in boiler work, various sizes of disks, rings, and other



Sheet Metal Cutter made by W. J. Savage Co., Inc.

circular forms, etc. The arrangement of the cutting member is such that openings in sheets or plates may be cut without starting from the outer edge. The stock is fed past the cutter by hardened rollers so that the operator, who may be unskilled, simply guides the work for cutting to the required outline. This type of machine is made in four different sizes designated as Nos. 0, 1, 2, and 3. The cutting speed on the different machines may be varied according to the nature of the work. For instance, on a No. 1 machine, which has a capacity for cutting stock up to and including 3/16 inch thick, the cutting speed is 30 inches per minute on the maximum thickness. The No. 2 machine, which will cut stock up to and including ⅜ inch thick, has a cutting speed varying from 18 to 84 inches per minute, whereas, on the No. 3 machine, the maximum capacity for thickness is ⅝ inch and the speed variation from 20 to 60 inches per minute. The designs on the stock to be cut may be laid out close

together without danger of the stock buckling, and the cutter leaves a clean kerf and both edges true. The No. 2 machine which is shown in the illustration has a 36-inch throat and weighs 3600 pounds.

NOBLE & WESTBROOK GRADUATING AND MARKING MACHINE

To provide for the performance of graduating operations where accuracy of the product and speed of operation are required, the Noble & Westbrook Mfg. Co., Hartford, Conn., has recently placed on the market a machine which is illustrated in Fig. 1. As the machine is power-driven, the placing of pieces of work in the machine and removing them when the operation has been performed, are the only duties required of the operator. Provision is made for holding the work in the proper relation to the graduating die and the depth of the marking is governed by means of a foot-lever, cam, and weight which are governed

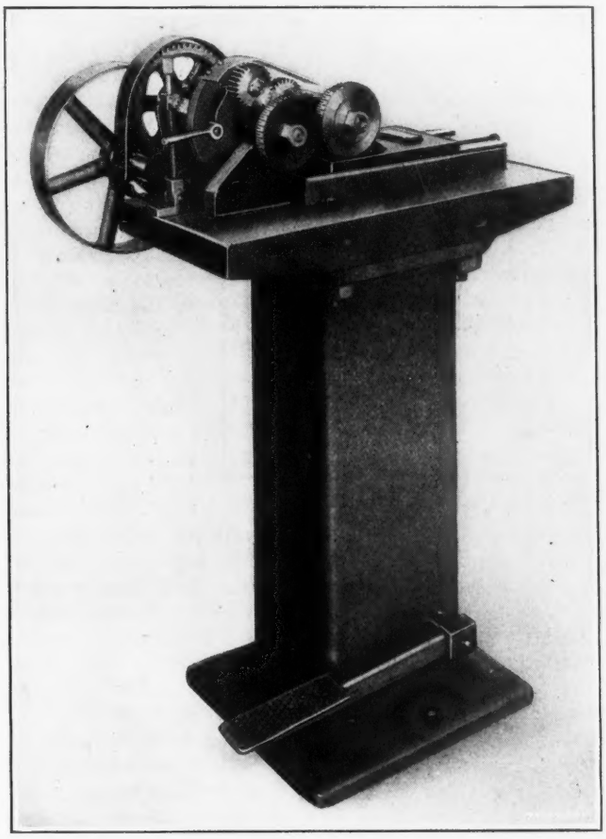


Fig. 1. Improved Type of Graduating and Marking Machine built by the Noble & Westbrook Mfg. Co.

by a positive stop that is adjustable to provide for making any desired depth of lines. This insures making even and accurate impressions. The machine is equipped with steel spindles, adjustable bearings, and is fully automatic in operation, being stopped by means of a clutch on the spindle which drives the marking die. An idea of the range of work for which the machine is adapted will be gathered by referring to Fig. 2, which shows some of the pieces that have been graduated and marked. Parts of various diameters can be graduated by changing the position of the intermediate gear located on the adjustable sector. Practically all types of modern machine tools are equipped with micrometer adjustments, and this machine is well adapted for the graduation of the dials used on micrometer adjusting screws.

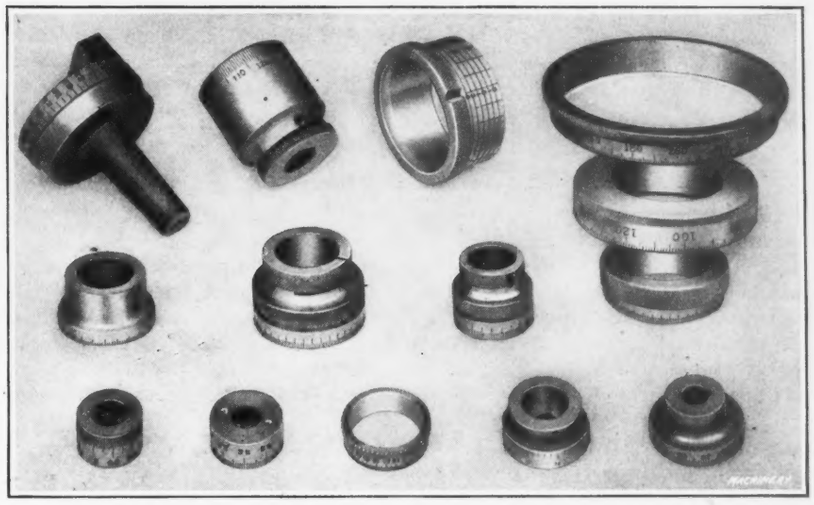


Fig. 2. Examples of Graduating and Marking done on the Noble & Westbrook Machine shown in Fig. 1

BARRETT-CRAVENS LIFT TRUCKS

The Barrett-Cravens Co., 713 Transportation Bldg., Chicago, Ill., has added to its line of lift trucks two new types known as models H and Y, which have capacities for carrying loads of 5000 pounds. The model H truck is 20 inches wide and is particularly designed for carrying heavy but narrow loads through congested corridors where the amount of available space is likely to be limited. The model Y truck is 27 inches in width and is intended for handling bulkier loads, although the carrying capacity is the same, so far as weight is concerned. Both models are built either 42, 48, or 60 inches in length, or longer to special order. Their heights, when lowered, are 7, 9, or 10 inches, but they can also be made higher to special order.

It is claimed for these new models of lift trucks that they are of exceptionally simple design and that a minimum number of bearing points are used, these bearing points being liberally proportioned to afford ample durability. The handle that operates the lifting mechanism connects directly with the upper frame, there being no connecting links. The handle automatically disengages from the upper frame when the load is raised and remains upright if desired when the truck is not in use, or it may be dropped to within 15

Heavy-duty Lift Truck built by the Barrett-Cravens Co.

inches of the floor. An automatic safety lock holds the load in the raised position, this lock being built of cold-drawn casehardened steel. In accordance with government specifications, all Barrett lift trucks are painted olive drab and the wheels a brilliant red.

HAGMAN SAFETY CLUTCH

To provide for the safety of factory employes, the Hagman Machine Works, Solar and West Division Sts., Syracuse, N. Y., are now manufacturing a safety clutch which can be manipulated by any employe who has to use machinery driven by a main lineshaft. The clutch is operated by simply pushing an electric button, and the following claims are made for it. In case of accident several persons have absolute and instant control of the clutch and can stop the machinery from several parts of the shop. The shifter lever on each machine is provided with a push-button, and a similar button can be placed within reach of each work-bench. Drop-cords carrying such buttons can also be distributed through the shop. With such an arrangement positive control of the power driving the mechanical equipment of the shop is within close reach of every employe, and in the event of accident there is little doubt that someone will have presence of mind enough to stop the machine as quickly as possible. After once being stopped, the machinery cannot be started again without a special effort being made to do so. There are many plants where several departments are operated from a single power plant, and in such cases each department can be run independently of the others by providing these clutches which can be promptly engaged or disengaged as the occasion arises. The clutches may also be the means of preventing serious accidents to machine operators. In the event of a worker's clothing becoming caught, he is likely to be drawn into the moving parts of a machine and seriously injured. In such cases, where there is only one point at which power can be cut off to stop the machines, it may be difficult, if not impossible, to get action quick enough to prevent a serious accident. Where, however, there are independent points of control distributed all through the shop, someone is likely to act in time to prevent serious trouble.

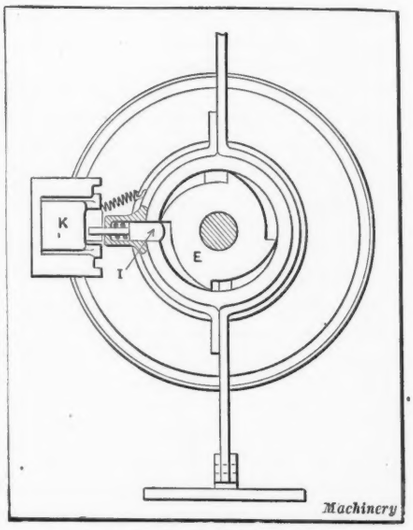


Fig. 3. Detail of Clutch Mechanism

In Fig. 2 is shown a detailed illustration of the mechanism of the Hagman safety clutch. The loose pulley is shown at *A* and the main shaft at *B*, while at *C* there will be seen the member of the clutch which is secured to the shaft. Provision is made for securing the loose pulley *A* to the main shaft *B* by means of dogs *D*. Cam *E* (see Fig. 3), which is loosely mounted on the main shaft *B*, is acted upon by the force of spring *F* to create a brake between members *E* and *C* to provide for overcoming the momentum of the main shaft. Pivot locks are employed to prevent the dogs *D* from falling back into position after the operation of the clutch. Lever *H* provides for setting the dogs *D* into position to continue the operation of the clutch. Plunger *I* (Fig. 3) is located on lever *J* and operated by electric current through a magnet *K* which unlocks lever *J* and allows plunger *I* to stop cam *E*, which throws out the dogs *D* and causes the driver to have no effect upon the shaft. A spring *L* holds lever *H* in position from where it can be operated only by hand to throw the machinery into operation after the use of the clutch. Buttons should be placed at each machine and elsewhere so that they are available for the use of practically all employes who have anything to do with the operation of mechanical equipment. These buttons work in connection with magnet *K* to operate the clutch by putting plunger *I* into motion. Attention is called to the fact that the same power used to run the machinery is utilized through the transformer to operate the clutch; therefore, when the machinery is in operation, the clutch can be relied upon. A lock on the magnet prevents plunger *I* from operating until it is released by the magnet through operation of the push-buttons.

The preceding description indicates how the object of the clutch has been attained by comparatively simple means and without undue complications in the design of the mechanism.

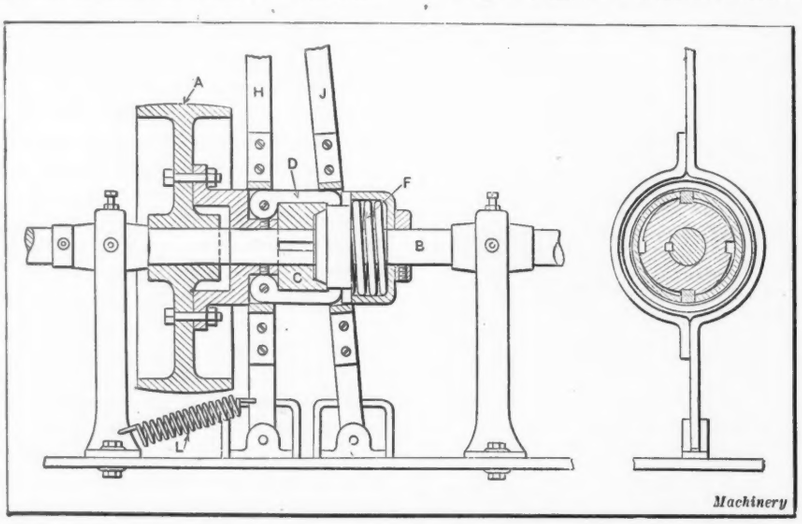


Fig. 2. Arrangement of Mechanism of Hagman Safety Clutch

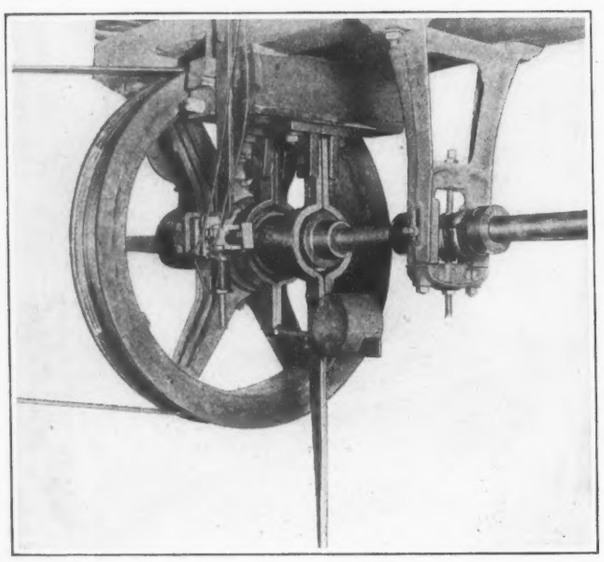


Fig. 1. Hagman Safety Clutch

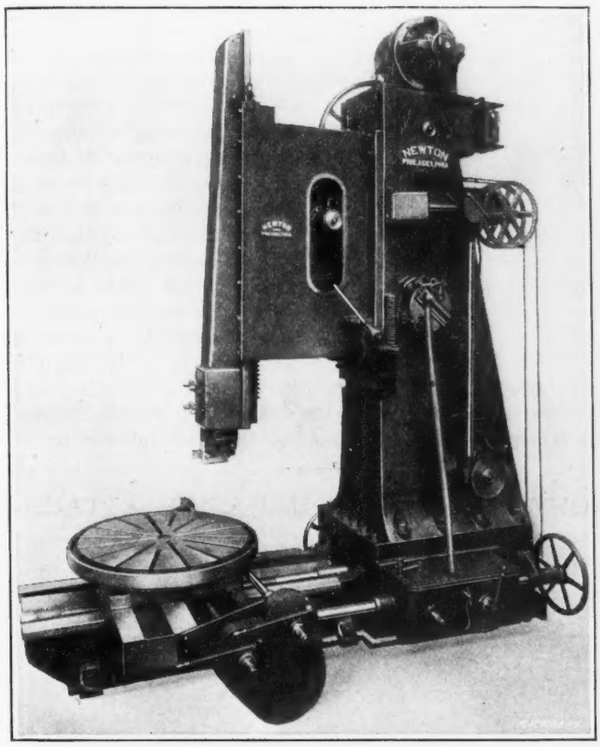


Fig. 1. Upright Generating Planer with 72-inch Stroke, built by the Newton Machine Tool Works, Inc.

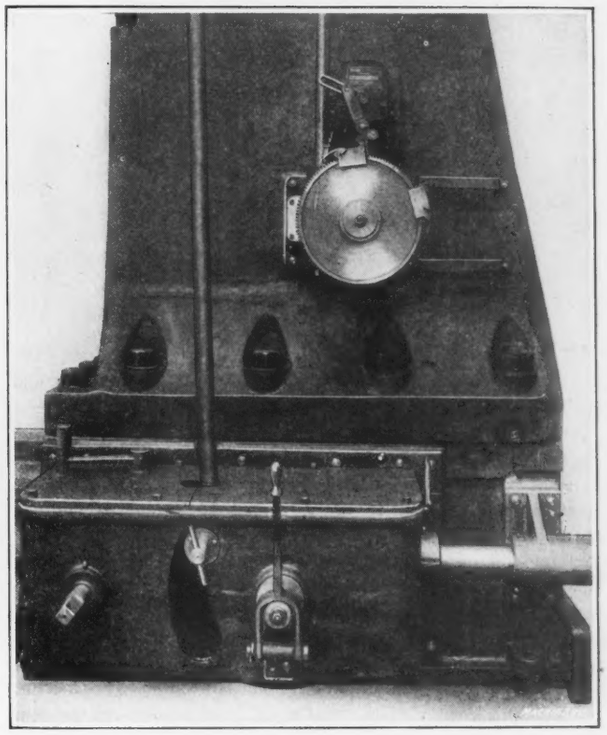


Fig. 2. Close View of Means provided for controlling Stroke of Newton Upright Generating Planer

NEWTON UPRIGHT GENERATING PLANER

On account of the great variety of uses to which slotting machines are put in the different machine shops where they are employed, the Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., has decided that the commonly used name is by no means descriptive, and they have therefore adopted the name "upright generating planers" to designate machines of this type. Fig. 1 shows one of the latest designs of Newton upright generating planers, with a 72-inch stroke; and Fig. 2 shows a close view of the stroke control. With this device, provision is made for setting the trips while the machine is in motion, which is a desirable feature, as such adjustments of stroke must often be made. In this illustration the control apparatus is shown located at the bottom of the upright column where it is within reach of the operator. Fig. 3 shows the duplex control of the hand elevation for the cutter-bar ram. It will be seen that an adjusting rack is provided on each side of the frame, and the adjustment is effected by means of worms and wormwheels which are arranged to be opposed in directions of rotation. An idea of the efficiency with which these machines operate will be gathered by referring to Fig. 4, which shows some chips produced on one of these machines at the Heppenstall Forge & Knife Co.'s plant at Pittsburg, Pa.

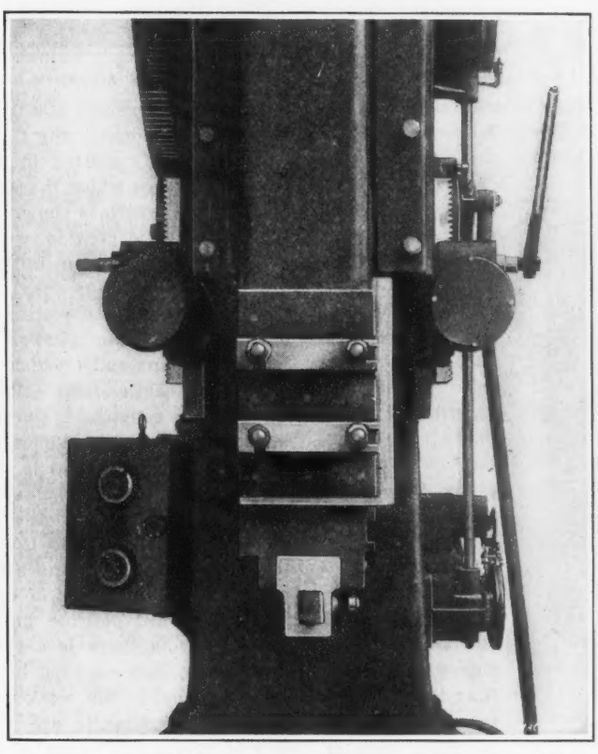


Fig. 3. Duplex Control for the Hand Elevation of the Cutter-bar Ram

These Newton rack-driven upright generating planers are built in sizes ranging from a 36- to a 72-inch stroke, and attention has already been drawn to the fact that it is the maximum sized machine which is shown in Fig. 1. The machines are equipped with reversing planer-type motor drive, and the motor speed should be between 400 and 1200 revolutions per minute, with a speed ratio preferably of 3 to 1. Rapid traverse for the table motions can be provided as a special feature when so desired, through the incorporation of suitable mechanism and the use of an extra constant-speed motor. These upright generating planers are claimed by their builders to possess the features of convenience of control, provision for maintaining permanent accuracy of alignment, and capacity for rapidly removing excess metal from forgings and similar parts. The rams or cutter-bars are counterweighted and carried by square bearings in guides with tapered side adjusting shoes. On all sizes of machines the vertical clamping surface is made solid and steel-faced, with suitable tool-holding clamps. Beneath the ram or cutter-bar is mounted an improved type of swiveling relief tool-box apron which can operate in any position through a complete circle. Motion is transmitted from the motor to the broad-faced steel rack on the back of the cutter-bar or ram through all-steel spur reduction gears. The coarseness of pitch and width of face of the gears increases with the reduction

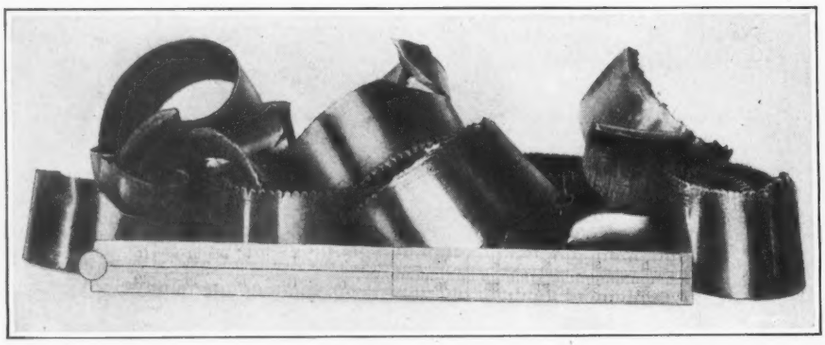


Fig. 4. Chips produced by Newton Upright Generating Planer shown in Fig. 1

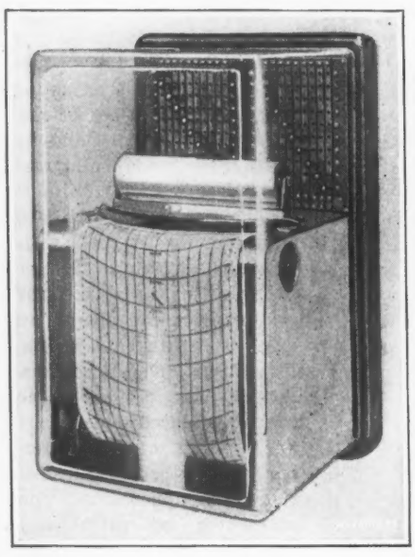
of the gear speed, so that proper compensation is provided for the increased severity of service.

All gears are covered, and on the operating side of the machine all gears are completely enclosed. The circular table is heavily ribbed and liberally proportioned; it has a full bearing on the saddle to which it is held by corner clamps. An oil-pan is cast integral with the circular table and graduated on the outside through a complete circle. The table saddle has a narrow guide alignment control with centralized location of the feed-screw and taper shoe control for the fit of the slide. Hand adjustment of the saddle is provided for from both ends of the cross-slide, and all feed motions are independently clutched, the clutches having independent levers. The cross-slide is of heavy box section and has square bearings on the base. Adjustment may be effected from the operating side as well as from the front of the machine. The feed-screws are provided with bearings on each end to insure operation under tension.

Feed motion is taken from a box on the outside of which the pawl rod stroke adjusting screw is located. The circular, cross, and longitudinal feeds are variable in their rate and reversible through the use of a pawl and ratchet wheel. The cutter-bar guide on the 36-inch stroke machine is cast integral with the frame, and therefore does not have any vertical adjustment. The cutter-bar guides on the 56- to 72-inch stroke machines, inclusive, are made separate from the frame and have vertical hand-controlled adjustment for locating them relative to the cutter-bars.

HOSKINS MULTIPLE RECORDING PYROMETER

A multiple recording pyrometer has been developed by the Hoskins Mfg. Co., 459 Lawton Ave., Detroit, Mich., which is said to be featured by extreme simplicity. It is operated with chromel thermo-couples which the user can make for himself. The meter will make any number of temperature records from one to ten. When ten records are being made, the temperature of a given furnace is recorded every ten minutes, and when used as a single-point recorder, the record is practically continuous. If less than ten temperatures are being recorded, greater frequency of readings can be obtained for any desired thermo-couple by properly locating the plugs in the switchboard, shown in the upper part of the accompanying illustration.

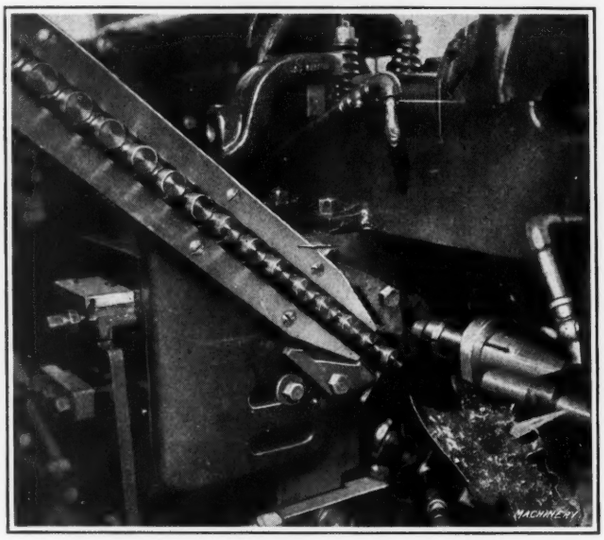


Multiple Recording Pyrometer made by the Hoskins Mfg. Co.

The record appears as a series of red-inked dots, and when the temperature of a given thermo-couple is being recorded, three readings are indicated within a one-minute interval, when the temperature of the next furnace commences to be recorded. The moving parts are said to be very few in number, and are operated by a solenoid which is energized by a lighting circuit. Every twenty seconds, this solenoid is energized and advances the chart, and at the end of each minute changes the rotary switch over to the next thermo-couple circuit.

CONE AUTOMATIC MAGAZINE ATTACHMENT

For use on automatic screw machines of its manufacture, the Cone Automatic Machine Co., Inc., Windsor, Vt., is now making the magazine attachment which is shown in operation in the accompanying illustration. This device consists of a main body casting in which there is cut an inclined channel through which the work slides. Because of the head on the work which is shown in the magazine attachment, it was necessary to provide two strips, in the present instance, to keep the pieces from falling out. In any case, the parts are fed downward by gravity to a stop at the end of the magazine, where the piece in the lowest position is lined up with one of the spindles of the machine. This spindle carries a spring collet which is moved forward to allow the chamfered mouth of the collet to grip the work.

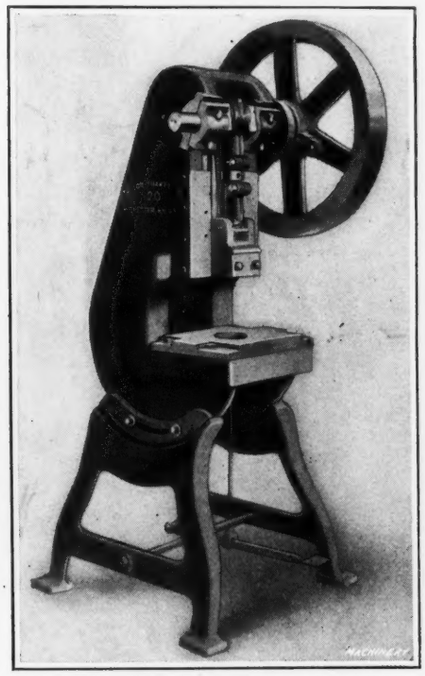


Automatic Magazine Attachment built by the Cone Automatic Machine Co.

Before the collet has secured a grip on the work, its tapered sides engage two latches springing them outward. The function of these latches is to prevent the piece of work at the bottom of the magazine from falling out. The spindle carrying the collet with the work in place in it causes the work to be delivered to the work-spindle of the machine, after the entire magazine attachment has moved backward out of the common line of centers. The magazine remains in its backward position until it is time to load the next spindle. Then there is a repetition of the cycle of movements which are required to transfer a piece of work from the magazine to the work-spindle of the machine. These magazine attachments are usually made to order with a view to having them adapted for the particular requirements of the work which is to be handled on the machine.

TAYLOR-SHANTZ INCLINABLE POWER PRESS

The Taylor-Shantz Co., Rochester, N. Y., is now building an inclinable power press of the type shown in the accompanying illustration. This press is adapted for handling a wide range of work. It is equipped with a clutch of simple design which is said to be positive and reliable in operation. The shaft can be turned to assist in setting the dies, while the wheel is in motion, as the press cannot be tripped while the slide is down. The wheel can also be turned back to release a punch if it becomes stuck in the die, or in fitting a punch to a die. The frame of the machine is heavily reinforced at the throat and designed to provide ample strength above the bearings. The slide is provided with adjustment for wear by means of a single 45-degree gib which forces the slide against two solid bearing surfaces, thus reducing lack of alignment to a minimum. The shaft is machined from a forging made of a special grade of steel. A knock-out in the slide may be furnished as special equipment if desired.

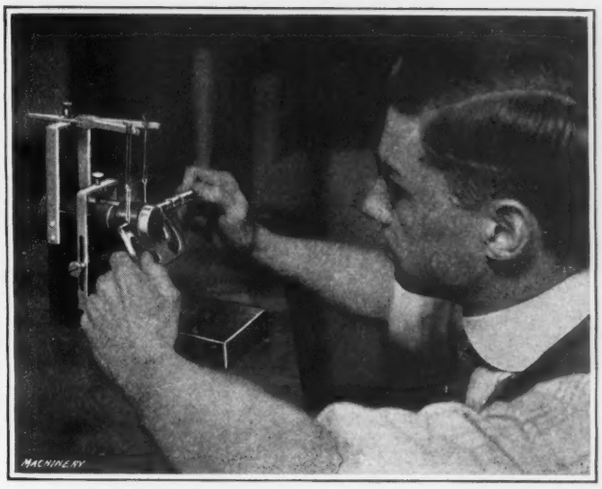


Inclinable Power Press built by the Taylor-Shantz Co.

The principal dimensions of the machine are as follows: Opening in the bed, front and back or right and left, 10 by 10 inches; width of opening in back, 8¼ inches; width between gibs, 5¾ inches; distance from bed to slide with stroke down and adjustment up, 7¼ inches; standard stroke of slide, 2 inches; adjustment of slide, 4 inches; distance back from center of slide, 7¼ inches; recess in slide for round punch stem, 1½ inch; area of bolster, front to back, 14 inches; right to left, 18½ inches; thickness of bolster, 1¾ inch; diameter of flywheel, 30 inches; face width of flywheel, 4 inches; weight of flywheel, 370 pounds; speed of flywheel, 125 revolutions per minute; height from floor to center of crankshaft, 63 inches; spacing of legs, 34 inches front to back and 30 inches right to left; floor space occupied by machine, 40 by 35 inches; and approximate weight, 2000 pounds.

SEABOLDT THREAD INSPECTING APPARATUS

This thread gage inspecting device is now being manufactured by the B. Seaboldt Corporation, 25 West Broadway, New York City, for use in conjunction with the Seaboldt standard measuring wires for measuring male thread gages. This device is intended to be used in conjunction with a micrometer. In operation, the plug gage is placed in the vee of the apparatus and the thumb-screw is adjusted downward, contacting with the gage and holding it securely. The wires are suspended from the arms above by cotton threads, the arms being adjustable universally, making it possible to place the wires wherever desired. In this position it is very simple to measure over the wires with a micrometer, thereby overcoming all the difficulties of trying to hold the

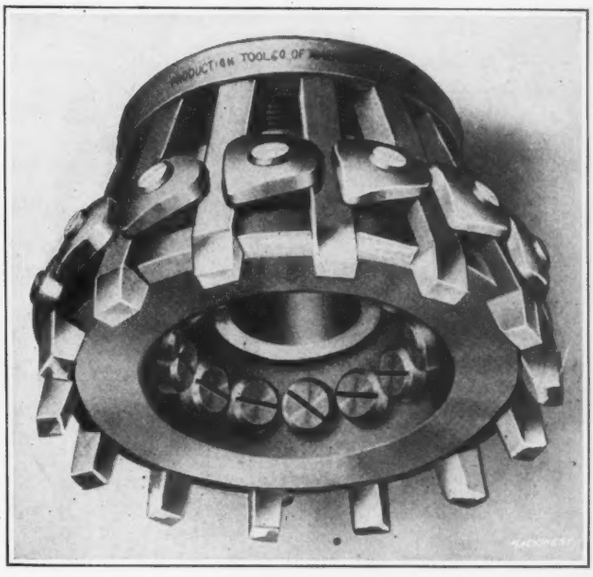


Thread Inspection Apparatus made by the B. Seaboldt Corporation

five members, gage, wires, and micrometer. The device is simply made, consisting of only three important members. The base is made of cast iron and resembles an angle-iron with a vee cut in the top of the upper member. The thumb-screw is comparatively short, but provision is made for measuring a large variety of gage sizes by the adjustment of the thumb-screw yoke. The only other member of importance is the yoke, which carries the two split wire-holding fingers.

PRODUCTION SURFACE MILLING CUTTERS

The Production Tool Co. of America, Detroit, Mich., is now manufacturing a surface milling cutter, with inserted teeth, as shown in the illustration, which is intended for use with the heavy feeds that it is necessary to employ on high-duty milling machines. The design has been worked out in such a way that these milling cutters have free cutting properties and the firmness of the clamping method enables the tools to give equally satisfactory results on solid steel pads or on thin or chilled castings. Square bits of high-speed steel are used, and provision is made to allow for repeated adjustment for grinding before the bits are finally too short for further use in the milling cutters, although they can still be used in lathe or shaper tool-holders. It is claimed for these new milling cutters that their first cost is low and that they are capable of giving satisfactory service during a long operating life.



Surface Milling Cutter with Inserted Teeth made by the Production Tool Co. of America

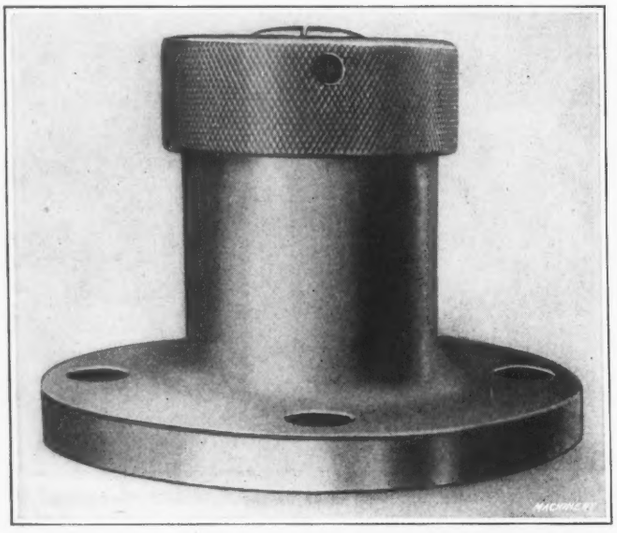


Fig. 1. Collet Lathe Chuck made by the E. W. Bemis Machine Co.

BEMIS COLLET LATHE CHUCK

The collet chuck shown in the accompanying illustrations has recently been placed on the market by the E. W. Bemis Machine Co., 92 West St., Worcester, Mass. Although this is primarily a lathe chuck, it can also be adapted for use on various other types of metal-working machinery. A distinctive feature of the design is the method employed for operating the collet jaws to center and hold the work. These jaws are said to have absolutely no longitudinal movement. They are held securely in the chuck body and do not ride upon it; instead, a closing member rides upon the taper of the jaws to provide for opening or closing them. Under no conditions can the jaws advance toward or back away from the cutting tool, and as a consequence absolute uniformity of length of the work is assured, so far as the chuck is concerned. It will be seen that the chuck consists of a body *A*, reinforced by a sleeve *B*, which is threaded to receive the chuck closing member *C*. This closing device is knurled to provide for operation by hand, which is the means generally employed, although it is also provided with holes to receive the pins of a spanner wrench. The collet jaws which are interchangeable for varying sizes of work, screw into the steel nut *D* and are firmly held in place by the headless screw *E*. This chuck is made in two styles; one with a flange for bolting to a faceplate, and the other threaded to screw onto the nose of a spindle. The chuck is furnished in two sizes, the smaller of which takes collets from 1/32 to ½ inch in diameter, while the larger takes collets from 1/16 to 1 inch in diameter.

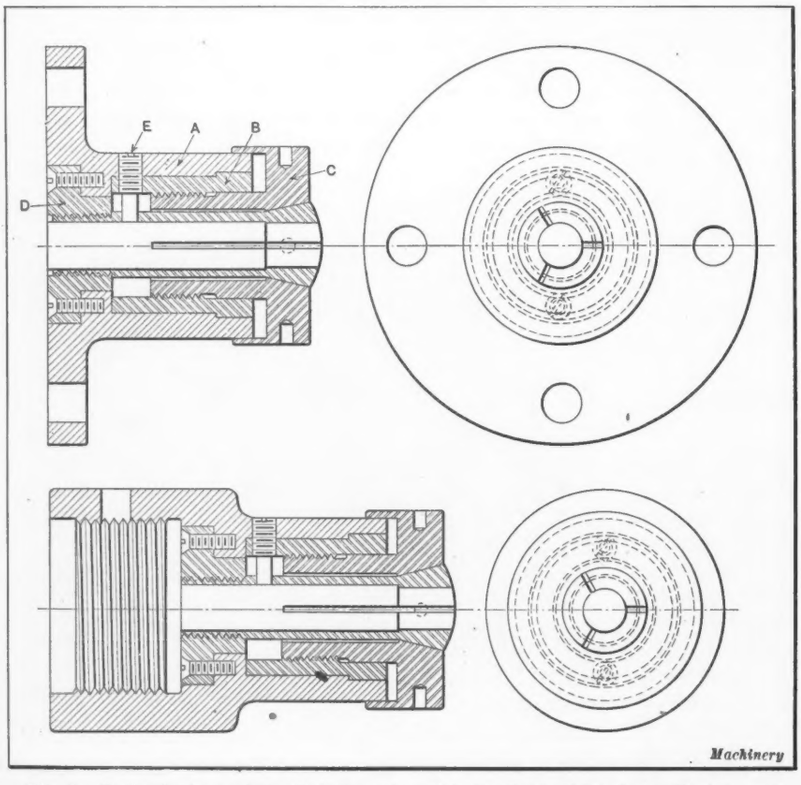
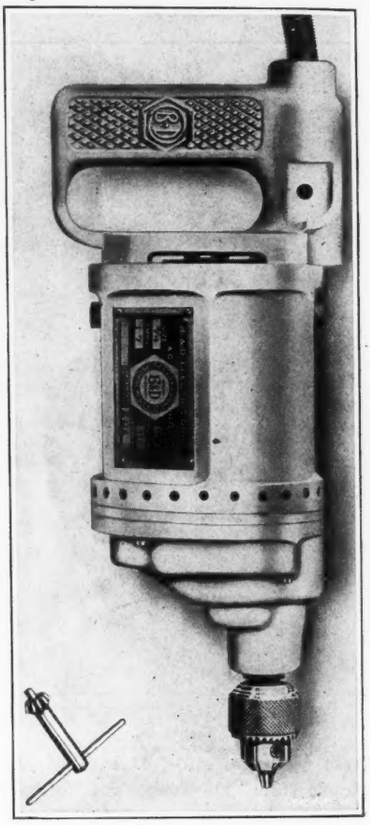


Fig. 2. Sectional Views of the Two Types in which the Bemis Collet Lathe Chuck is made

BLACK & DECKER PORTABLE ELECTRIC DRILL

An extremely light-weight portable electric drill has recently been placed on the market by the Black & Decker Mfg. Co., 10 Guilford Ave., Baltimore, Md. This tool will take any size of twist drills up to 3/16 inch in diameter, and it is equipped with a series compensated motor. The dimensions are 4 inches in diameter by 12 inches over-all length, and the tool can be operated from an ordinary electric light socket on either alternating or direct current. The drill weighs only 6⅜ pounds, which is a remarkably low weight when the capacity of the tool is considered. With a no-load speed of 1600 revolutions per minute, the full load energy consumption is 175 watts, the speed under these conditions being 1000 revolutions per minute. This tool is especially designed for drilling small holes in steel, iron, or wood.



Light-weight Portable Electric Drill made by the Black & Decker Mfg. Co.

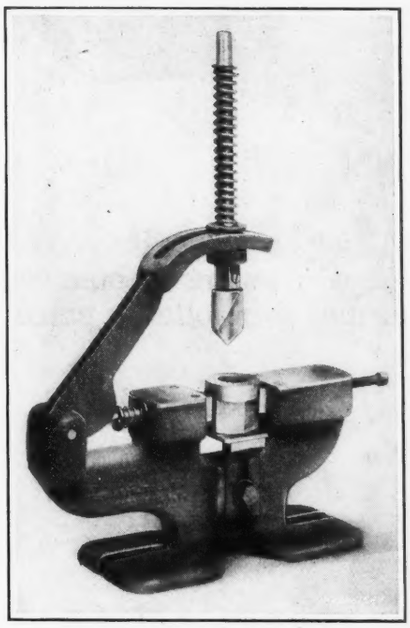
SKELTON BURRING FIXTURE

The burring fixture manufactured by the Skelton Sales Co., Syracuse, N. Y., is for performing burring, countersinking, chamfering, reaming, or similar operations on parts after they leave the screw machine. The accompanying illustration shows the fixture as applied to the burring or chamfering of tapped holes. It may also be employed for such work as chamfering the corners of pins, screws, etc., by using a tool of the hollow-mill type. This fixture may be attached to any small drilling machine and it is made in

two sizes designated as Nos. 1 and 2. The No. 1 has a jaw capacity up to ¾ inch diameter and will take pieces varying from 1/16 to 1½ inch long. The No. 2 size has a jaw capacity up to 2 inches in diameter, and will take pieces varying from 1/16 to 2 inches long. The spindle of the burring tool passes through the slotted end of the cam-lever which closes the work-holding jaw as the tool descends. It is simply necessary for the operator to place the work in position with one hand and operate the lever of the machine with the other. As one piece is inserted, the completed part is pushed out and slides down a chute into a receptacle. The pressure on the work is governed by the strength of a spiral spring acting against the slotted end of the lever. As the adjustments are simple, very little time is lost in making changes for different pieces of work.

TITAN PNEUMATIC HAMMER

The Titan pneumatic hammer which is being placed on the market by the Titan Automatic Tool Co., 25 W. Broadway, New York City, is noteworthy both as regards its simplicity of design and its range of adaptability. Its scope is as broad as that of the well-known pneumatic hammer, and it is said to fill all the functions of that type of tool. The Titan hammer is manufactured in all the ordinary sizes, but in addition it is made in very small sizes for engraving and other work of that nature. One of the chief claims made for this hammer is its portability. A complete outfit is illustrated in Fig. 1, showing a 1/3-horsepower motor, flexible shaft, and the hammer proper. Unlike other pneumatic hammers, which usually require an air storage tank, this one is operated by air which is generated within itself. The motor and flexible shaft are of ordinary construction, and hence this description will relate largely to the operation and construction of the hammer.



Skelton Burring Fixture which is applied to a Drilling Machine for burring, chamfering, counterboring or reaming Parts after they leave the Screw Machine

In outer appearance the hammer resembles that of the ordinary pneumatic hammer, but instead of being connected to the source of power by a rubber air hose, it is connected with a flexible shaft through which the power is transmitted to the hammer. The construction is comparatively simple, the main hammer consisting of only thirteen parts which are clearly illustrated in Fig. 2. The principal parts consist of the body *A* and *B*, Fig. 3, piston *C*, cylinder *D*, sleeve *E*, floating plunger *G* and tool guide *H*.

In operation, the piston *C* is reciprocated by the crank *J* through the medium of the connecting-rod *K*. Inasmuch as there is a free passage for the air through the port holes *L* in the cylinder *D* which line up when in the neutral position with channels in the sleeve *E*, the atmospheric pressure on both ends of the floating plunger *G* is practically the same, causing no action of the plunger, although the piston is reciprocating. As soon as the operator of the hammer exerts pressure on the tool from the handle end of the hammer, the cylinder *D* is pushed upward against the pressure of the spring. In so doing the first row of port holes *L* are covered up, causing the piston to reciprocate with a reduced area for the escape of air, which results in a reduction in the pressure of the air within the chamber, thus causing the floating plunger *G* to reciprocate in harmony with it. The force of the blow hit by the floating plunger *G* on the end of the chisel or other tool which projects through the tool-holder *H* will be light at first, but it increases gradually to the full power as the cylinder *D* is pushed further backward, covering up more and more of the port holes.

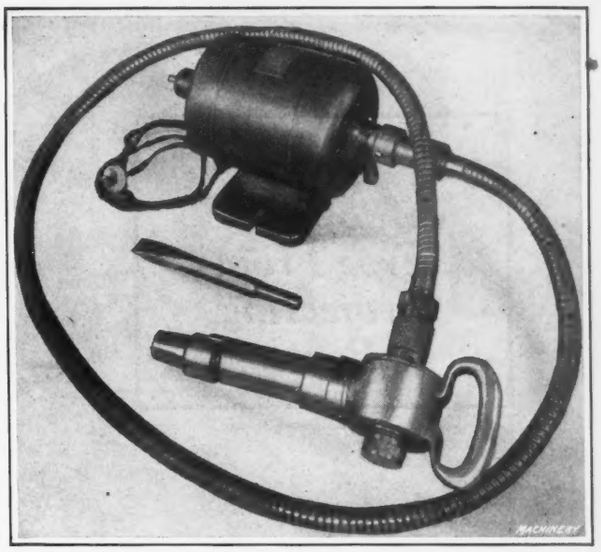


Fig. 1. Pneumatic Hammer made by the Titan Automatic Tool Co.

The blow is imparted to the chisel or tool by the impact of the floating plunger *G* on the end of the tool which protrudes a short distance above the shoulder *M* on the tool guide *H*. The tendency of the floating plunger *G* to hit as hard a blow

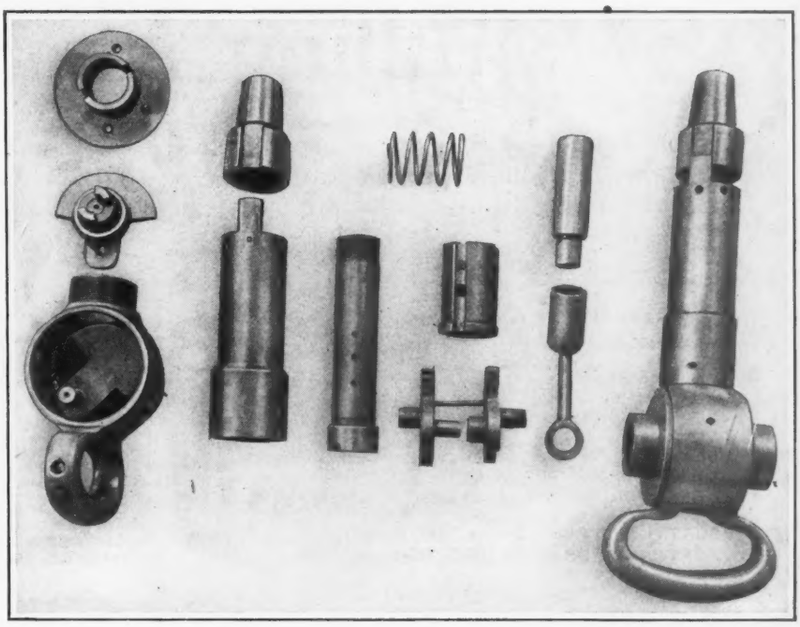
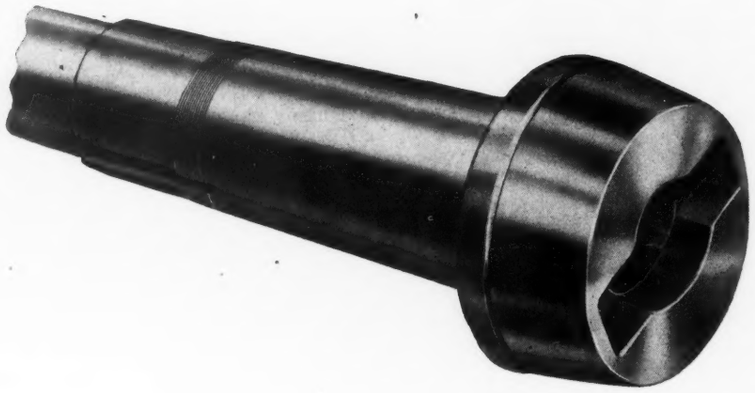
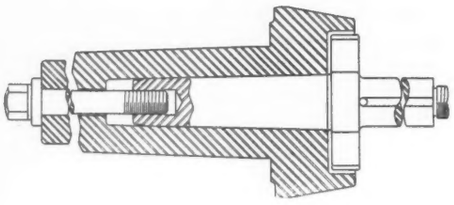


Fig. 2. Parts of the Titan Pneumatic Hammer shown in Fig. 1

Nose of Spindle Free From Projecting Parts

Only a





Clutch on arbor or collet fits recess in spindle and drawing-in bolt securely holds arbor or collet in place.

The taper-nose construction of the spindles of

Brown & Sharpe Milling Machines

is but one of the many features of these easy-to-operate, productive machines. Let us tell you about them in detail. See for yourself why they are so well equipped to stand the steady drive of your busy shop.

REPRESENTATIVES IN U. S. A.

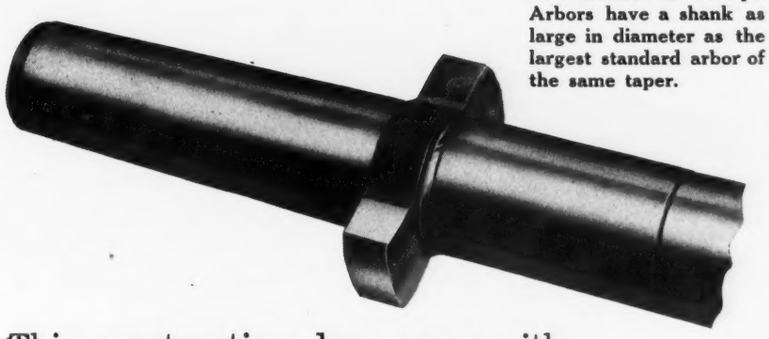
BALTIMORE, MD., Carey Machinery & Supply Co.
CINCINNATI, O., INDIANAPOLIS, IND., The E. A. Kinsey Co.
SAN FRANCISCO, CAL., Pacific Tool & Supply Co.
CLEVELAND, O., DETROIT, MICH., Strong, Carlisle & Hammond Co.
ST. LOUIS, MO., Colcord-Wright Machinery & Supply Co.
SEATTLE, WASH., Perine Machinery Co.
PORTLAND, ORE., Portland Machinery Co.

Brown & Sharpe
PROVIDENCE,

OFFICES: CHICAGO, ILL., 626-630 Washington Blvd.
PHILADELPHIA, PA., 1103-1105 Liberty Bldg.
PITTSBURGH, PA., 2538 Henry W. Oliver Building.

Brown & Sharpe of New York, Inc.
OFFICES: NEW YORK CITY, 20 Vesey St.
ROCHESTER, 415 Chamber of Commerce Bldg.
SYRACUSE, Room 419 University Block.

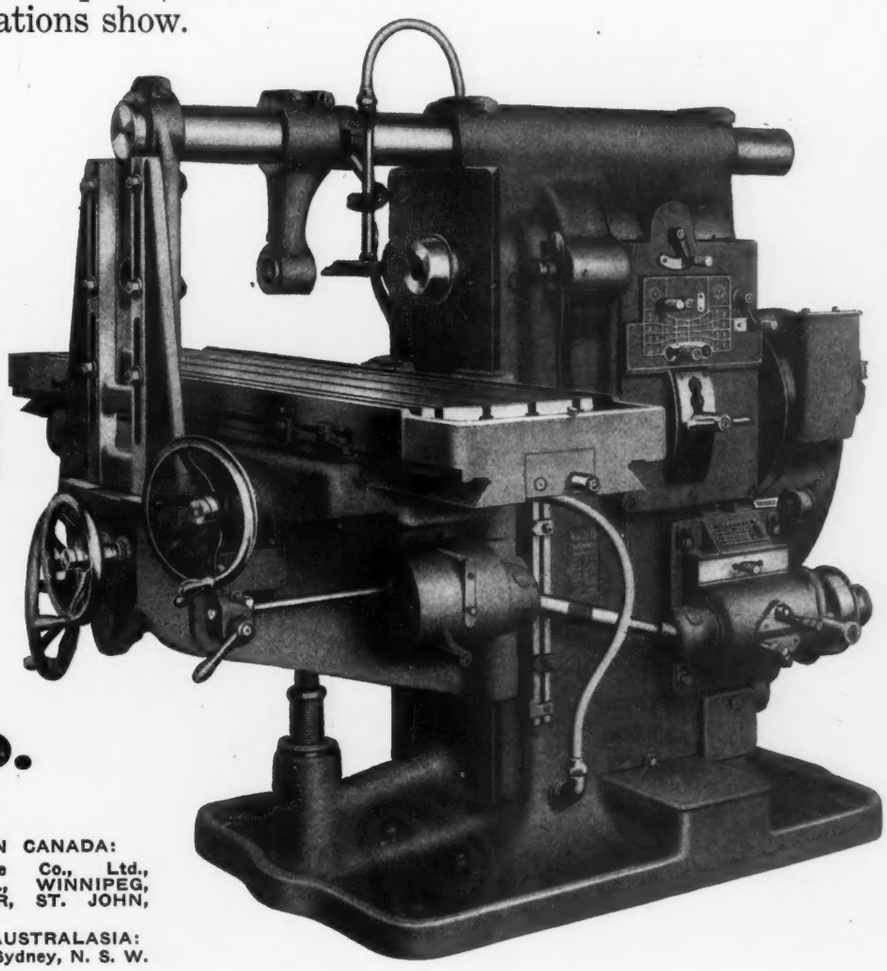
Drawing-in Bolt Required To Hold Arbors and Collets



All Brown & Sharpe Arbors have a shank as large in diameter as the largest standard arbor of the same taper.

No Drive Could Be More Positive

This construction does away with plates, screws or loose parts, as diagram and illustrations show.



SEND FOR OUR NEW BOOK ON BROWN & SHARPE MILLING MACHINES

Mfg. Co.
R. I., U. S. A.

REPRESENTATIVES IN CANADA:
Canadian Fairbanks-Morse Co., Ltd., TORONTO, MONTREAL, WINNIPEG, CALGARY, VANCOUVER, ST. JOHN, SASKATOON.

REPRESENTATIVE IN AUSTRALASIA:
R. L. Scrutton & Co., Ltd., Sydney, N. S. W.

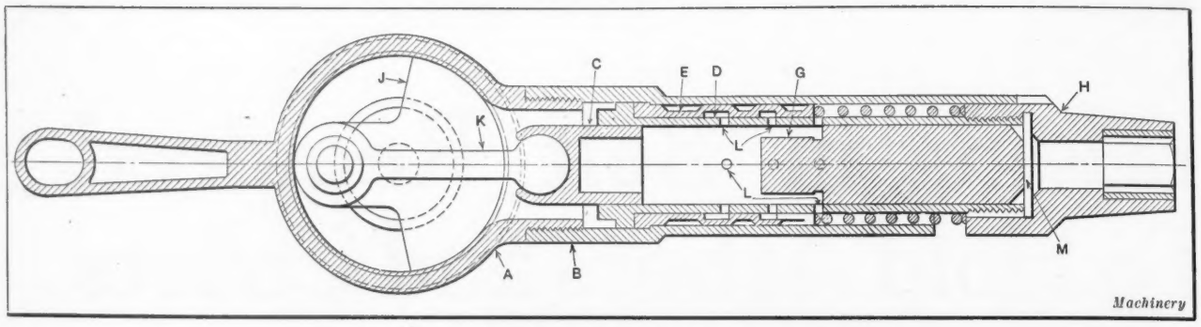


Fig. 3. Longitudinal Sectional View of the Titan Pneumatic Hammer

against the piston on the return stroke is neutralized by the cushioning effect that is obtained when the small end of the plunger enters the recess in the piston *C* which it fits loosely. The recess in the piston is slightly bell-mouthed and the end of the plunger is slightly tapered, so that they will enter one another readily.

The advantages claimed for the new Titan pneumatic hammer are its simplicity, low cost of operation, absence of valves and portability, since it is obvious that it can be quickly set up for operation wherever electric current is available. There is no long hose line required with its accompanying motor and air-compressor outfit. Another advantage of this hammer is the ability to obtain a graduated blow simply by the operator's pushing downward more or less on the operating handle, which causes the hammer to give a light or heavy blow as previously described. An entire outfit of this kind may be packed in a small portable case and moved from place to place with the greatest of ease.

LANDAU BACK-GEARED TAPPING ATTACHMENT

The Landau Machine & Drill Press Co., Inc., 19 W. 44th St., New York City, is now building a back-geared tapping attachment for which two claims are made. It is stated that having the spindle of the attachment back-geared, not only provides ample power, but through the reduction of speed secured in this way, the tapping operation is slowed down sufficiently so that danger of breaking the tap is greatly reduced. This attachment is adapted for tapping holes of the full length of the tap or where there are only two or three threads to be cut, and when the tap has reached the bottom of the hole the driving clutch automatically releases, thus protecting the tap from damage. This attachment is made in two sizes having Morse taper shanks. Attachment No. 1 takes taps up to 5/16 inch in diameter, and the attachment No. 2 takes taps from ¼ to 1 inch in diameter.

Fig. 1. Back-geared Tapping Attachment made by the Landau Machine & Drill Press Co., Inc.

This tapping attachment is designed for use on a standard drilling machine and the back-gears provide for reducing the speed of rotation between the drilling machine spindle and the spindle of the tapping attachment, to provide conditions of operation to which attention has already been called. The ratio of the back-gears is 5 to 1. When the tap has reached the required depth, the spindle is released and remains neutral; then when the direction of rotation is reversed, the tap is backed out at a ratio of 7 to 1. The reverse clutch of the tapping attachment is automatically engaged when the feed of the drilling machine spindle is reversed to back the tap out of the hole.

NEW MACHINERY AND TOOLS NOTES

Sine Bar: M & R Tool Co., 59 Mechanic St., Newark, N. J. A 3-inch sine bar which is intended for use with a perforated angle-plate or similar device. Seven holes are provided in order to attach the bar to the plate. The bar is lapped to size and guaranteed to be accurate.

Pipe Machine: Williams Tool Co., Erie, Pa. This concern is now building a line of pipe machines which may be equipped for either belt or individual motor drive. The die-head has a new design of cut-off, and a reaming tool is provided for removing the burr produced during the cutting operation.

Shell Lathe: Dale-Brewster Machinery Co., Inc., 541 W. Washington Blvd., Chicago, Ill. A machine known as the "Fulton Type B" munition lathe which is equipped with an all-geared headstock of the single-speed type, with all gears made of steel and the pinions of heat-treated steel. The drive shaft runs on three Hyatt roller bearings. The machine is built with either an 8- or 10-foot bed.

Pneumatic Hammer: H. Edsil Barr, Erie, Pa. A self-contained pneumatic hammer which was designed with the view of eliminating hand work on such operations as light forging, tool dressing, etc. This is a one-man machine and by making it self-contained and independent of outside means of operation, the hammer can be readily moved from place to place in the shop as occasion requires.

Sine Angle-plate: Kar Engineering Co., 79 E. 130th St., New York City. This equipment will measure angles in any part of the quadrant, without requiring the use of any special measuring tools except an ordinary micrometer caliper. The device consists of a movable plate swiveled on a stationary

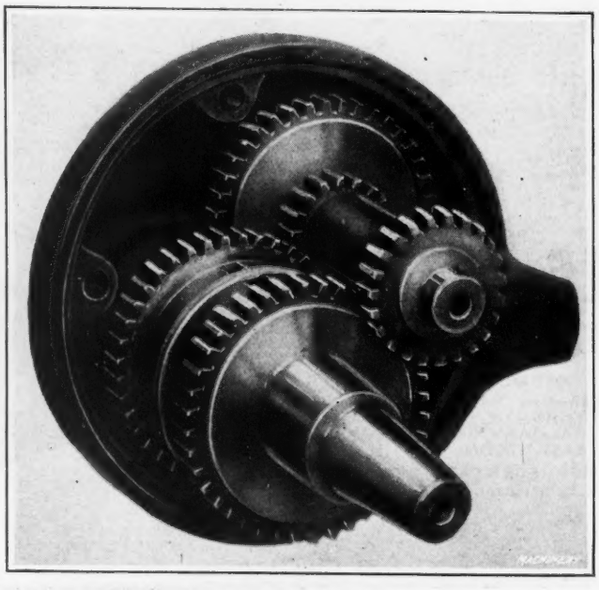
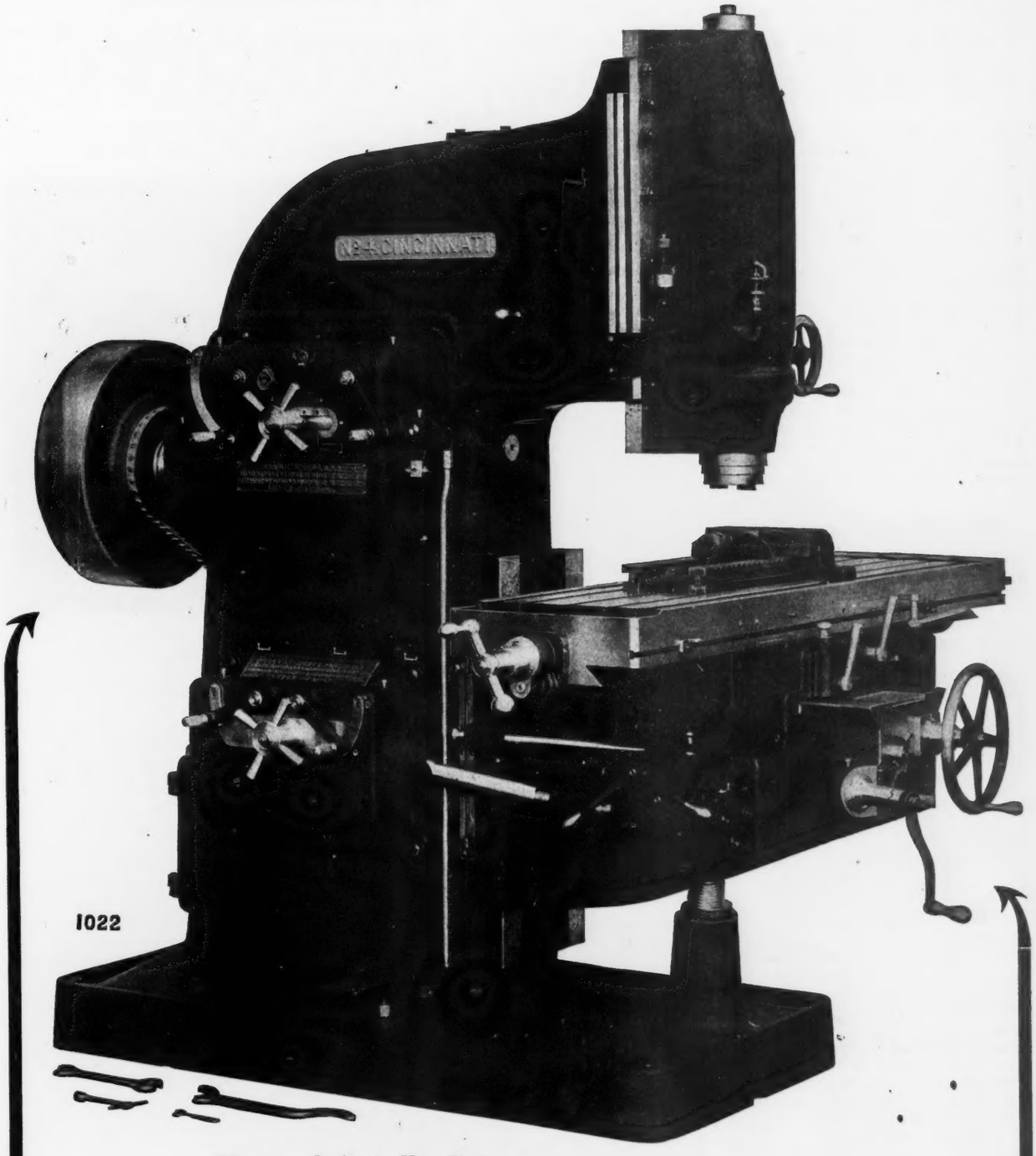


Fig. 2. Mechanism of Landau Tapping Attachment shown in Fig. 1

Cincinnati Verticals



Unusual Spindle Power.
Heat Treated Alloy Steel Hardened Gearing.
Massive Spindle Head Construction.
Handy—Can mill around a rectangle without stopping feed or speed.

These are some reasons why you should use Cincinnati Verticals

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI, OHIO, U. S. A.

base, the movement permitted being through a quarter circle. After making the desired setting, the instrument is clamped by a screw.

Sand-blasting Cabinet: Pangborn Corporation, Hagerstown, Md. The manufacture of cast shells requires each casting to be cleaned, and to meet the requirements of such work this corporation has placed a sand-blasting cabinet on the market. The apparatus consists of four revolving chucks which are driven at slow speed in order to rotate the shells during the period of sand-blasting and thus expose all surfaces on the work uniformly to the cleaning action of the sand.

Slotting Machine: Racine Tool & Machine Co., Racine, Wis. A slotting machine of the milling type, which is virtually an interior milling machine that operates a cutter of somewhat the general form of a broach. Although this is essentially a milling machine, in so far as the nature of its operation is concerned, the milling operations performed on the machine are usually on the interior openings in the work. In other words, it does those classes of work for which a slotting, broaching, or keyseating machine would ordinarily be employed.

Geared-head Lathe: Willard Machine Tool Co., Inc., Cincinnati, Ohio. This machine is of similar design to the 13-inch tool-room lathe built by this company, except that it is equipped with a geared-head and single pulley drive. There are internal ribs in the headstock that provide the necessary stiffness. Three changes of speed are obtained by sliding gears on the first shaft, which work in conjunction with two changes of speed provided by gears carried on an intermediate shaft to give six changes. Six additional changes of speed are available through the back-gears, so that a total of twelve changes of speed may be obtained.

* * *

MULTIPLE-SPINDLE DRILLING HEADS

Attention should be called to the fact that all of the half-tone illustrations, Figs. 1 and 2 and Figs. 10 to 15, inclusive, shown in the article "Multiple-spindle Drilling Heads," in the November, 1918, number of MACHINERY, page 229, were reproduced from photographs of drilling heads made by the Sellew Machine Tool Co., Pawtucket, R. I. The designs shown in the line engravings were also developed by the same company. While the drawings were made from sketches, and, therefore, may not illustrate the Sellew heads in detail, they show the practice of the Sellew Machine Tool Co. both as regards special and standard adjustable drilling heads. The only exception is that of the universal-joint drive for drill heads shown in Fig. 19, which is not used by the company mentioned.

PERSONALS

H. A. WILDER has been appointed purchasing agent of the Heppenstall Forge & Knife Co., Pittsburg, Pa.

A. W. TYLER has been elected vice-president and general manager of the C. A. S. Products Co., Columbus, Ohio, succeeding the late James W. Graham.

L. C. SPRAGUE has been appointed assistant secretary of the Chicago Pneumatic Tool Co., Chicago, Ill., with headquarters at 52 Vanderbilt Ave., New York City.

CHARLES M. SCHWAB, until recently director-general of the Emergency Fleet Corporation, was presented with an honorary membership in the American Society of Mechanical Engineers at its annual convention in New York City.

L. E. TOWNSLEY, manager of the Foreign Trade Department of Paul R. Ruben & Co., 16 California St., San Francisco, Cal., will leave the last of January for China, Japan, the Philippines, Dutch East Indies, Straits Settlements, and Australasia, to establish resident agents at principal ports.

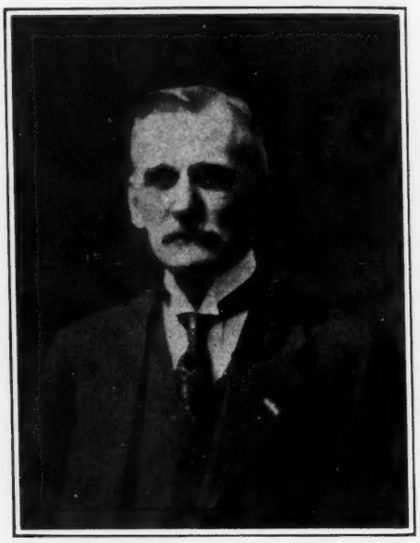
WILLIAM EHRLICH, after completing war service of ten months at the U. S. Government Explosives Plant, Nitro, W. Va., as engineer on progress for the Thompson-Starrett Co., has returned to New York City, and has become associated with the George H. Gibson Co., Tribune Bldg., engineering and editorial specialists engaged in the commercial development of mechanical businesses and their products.

H. W. CLARKE has been appointed advertising manager for the Chicago Pneumatic Tool Co., Chicago, Ill. Mr. Clarke has been identified with the engineering advertising field for many years and was for eight years employed with the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., part of the time as a member of the sales and publicity departments and later as western publicity representative with headquarters at Chicago. Later he was connected with the advertising service department of the McGraw-Hill Co., at the Chicago office.

OBITUARIES

AMBROSE R. GORSLINE

AMBROSE R. GORSLINE, for the last twelve years president of the Cochrane-Bly Co., Rochester, N. Y., died at his home after a brief illness, November 25, 1918. Mr. Gorsline was born at Parma, N. Y., in 1858, and came to Rochester with his parents in 1871. He received his education in the public schools and high schools of Rochester. After a varied experience in different lines of business, including banking, he took over the management of a flour mill in Rochester which had formerly been run by his father, who had retired from this work due to failing health. Mr. Gorsline ran this mill successfully for a number of years, but disposed of it after the death of his father and entered the Cochrane-Bly Co., devoting the best part of his life to this company, the success and reputation of which was largely due to his untiring efforts.



At the outbreak of the European war four years ago, Mr. Gorsline expressed the opinion that it was the duty of American manufacturers to make every effort to furnish England and France with the materials they so urgently needed, and after the entrance of the United States into the war, he took the attitude that all those who were not in the army were civilian soldiers. His own extreme efforts during the past four years undoubtedly hastened his death.

Mr. Gorsline was a man of strong personality and high integrity, and he was held in high esteem by the business community of Rochester. He was a member of the Rochester Chamber of Commerce and of a number of clubs and lodges. He is survived by his wife, Florence Scribner Gorsline.

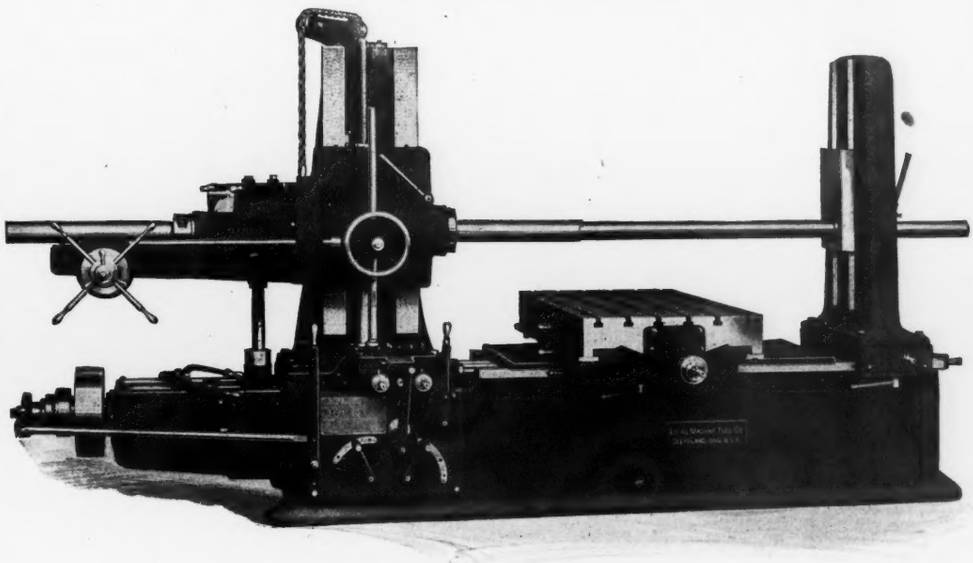
W. F. CURTIS, for the last thirty-three years manager of the New York office of the Union Mfg. Co., New Britain, Conn., died at his home in Montclair, N. J., December 8. Mr. Curtis had been confined to his home for nearly eight months.

HENRY CLIFTON BULLARD, purchasing agent of the Bullard Machine Tool Co., Bridgeport, Conn., and son of A. H. Bullard, secretary and treasurer of the Bullard Machine Tool Co., died December 9 at Bridgeport from acute pneumonia. Mr. Bullard was born in 1890, and was educated in the public schools and later in the University School of Bridgeport, Conn. He entered the Bullard organization in 1908 and became purchasing agent of the company in 1914. He was also secretary and treasurer of the Connecticut Gamewell Auxiliary Fire Alarm Co., Bridgeport, Conn., and a member of the Bridgeport Chamber of Commerce and the Purchasing Agents Association. He was married in July, 1917, to Miss Nellie C. Wilcox of Bridgeport, Conn., who died two days after her husband from the same cause—acute pneumonia.

EDWARD V. MCCONVILLE, sales manager and secretary of the Modern Tool Co., Erie, Pa., died November 26, of double pneumonia following a ten-days sickness of Spanish influenza. Mr. McConville was born in Northampton, Mass., in 1885, and was educated at the Toronto University, Toronto, Canada. He started his business career with the General Electric Co., Schenectady, N. Y., and then came to Erie, in 1909, as private secretary to Mr. Reynolds, engineer of construction for the General Electric Co.'s Erie plant. In 1911, he joined the sales organization of the Modern Tool Co., and for two years traveled for this company in New York and the New England states. Due to his unusual ability to apply himself to his work and to organize the efforts of others, his rise was rapid, and, since 1913, he was sales manager and secretary of the Modern Tool Co., in which position he was highly successful. He was married, in 1915, to Miss Josephine English, of Erie, Pa., who survives him.

The LUCAS
"PRECISION" BORING DRILLING MILLING MACHINE

is made in THREE SIZES—



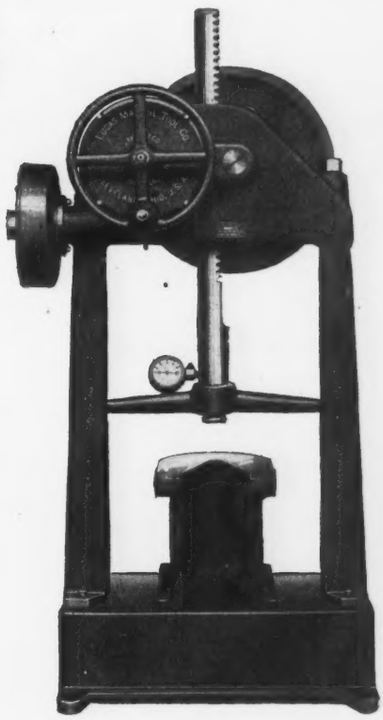
3, 3¾ and 4½ inch spindles respectively, of the same general design and all with the well-known

LUCAS Accuracy and Efficiency

Send for circulars or a salesman.

BROACHING

When the holes to be finished are so small that a long *draw* broach pulls apart, or when the amount of work does not justify investing in a regular BROACHING MACHINE



The LUCAS Power Forcing Press

is not only IDEAL for the work, but is always on hand for the many other jobs that *gravitate to it* soon after it is installed.

Look it Up!
(Don't be a Matthew Mears.)

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

BOOKS AND PAMPHLETS

Economical Use of Coal in Railway Locomotives. 76 pages, 6 by 9 inches. Published by the Engineering Experiment Station of the University of Illinois, Urbana, Ill., as Circular No. 8.

Handbook on Employment Management in the Shipyard. Bulletin No. 1. Issued by the United States Shipping Board Emergency Fleet Corporation, Philadelphia, Pa. 17 pages, 8 by 10 inches.

Second Annual Report of the Council of National Defence for the Fiscal Year Ended June 30, 1918. 275 pages, 6 by 9 inches. Published by the Council of National Defence, Washington, D. C.

Twenty-sixth Annual Report of the Maryland State Board of Labor and Statistics for 1917. 237 pages, 6 by 9 inches. Published by the Maryland State Board of Labor and Statistics, Equitable Bldg., Baltimore, Md.

Aids to Employment Managers and Interviewers on Shipyard Occupations. Special bulletin issued by the United States Shipping Board Emergency Fleet Corporation, Philadelphia, Pa. 147 pages, 6 by 9 inches.

Twenty-Ninth Annual Report on the Statistics of Railways in the United States for the Year Ended June 30, 1916. 755 pages, 9 by 11½ inches. Published by the Division of Statistics of the Interstate Commerce Commission, Washington, D. C.

Standardization of the Saybolt Universal Viscosimeter. By Winslow H. Herschel, associate physicist of the Bureau of Standards. 25 pages, 7 by 10 inches. Published by the Bureau of Standards, Washington, D. C., as Technologic Paper No. 112.

Making the Office Pay. By W. H. Leffingwell, author of "Scientific Office Management." 382 pages, 7 by 10 inches. Published by the A. W. Shaw Co., Chicago, Ill. Price, $4.

This book contains descriptions of the methods successfully employed by many large business concerns in dealing with the problems of office management upon which the success of their executive departments has been founded. This information is supplemented by concrete illustrations and is carefully indexed. The methods described represent the practice of many concerns throughout the country engaged in widely varying industrial pursuits, and it should enable the executive to check up the efficiency of his office organization as compared with the best present-day systems and to apply proved methods in bringing each branch of the office organization up to the standard efficiency.

Safety in Woodworking. 160 pages, 6 by 8 inches. Prepared and published by the National Workmen's Compensation Service Bureau, 13 Park Row, New York City. Price, $1.10.

This book is intended principally for the information of employers and employes engaged in the woodworking industry, but it should be of value to all industrial establishments, as its purpose is to give practical information in regard to the design and installation of guards for dangerous moving parts of machinery. Information is also given on many different factors which may be combined to insure the safety of life and property, such as proper lighting systems, lay-out of machinery and methods of transportation of the product. The book contains the standard specifications for materials used in making guards to meet different requirements, together with the standard dimensions which are generally applied in constructing guards. Illustrations made from actual photographs are employed to show the methods which have been found most efficient in providing guards for different types of woodworking machinery. The loose-leaf type of binding is employed in making up the book, so that new illustrations and data may be added from time to time as it is prepared by the publishers.

The A-B-C of Aviation. By Captain Victor W. Page. 274 pages, 5½ by 8½ inches. 130 illustrations. Published by Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.50.

This book is a practical treatise, outlining the elements of aeronautical engineering and containing simplified explanations of the theory of flight, aerodynamics, and basic principles underlying the action of balloons and airplanes, including instructions for lining up and inspecting typical airplanes before flight, and giving simple rules for flying. The book has been especially prepared for instructors and students in order to furnish an exposition of the airplane of a non-technical character. It is not intended to be an engineering treatise, nor is it intended to consider technical points that would interest only the designer, but it does consider the basic principles of airplane flight in such a manner that a student may readily grasp the subject. Those interested in aviation should find this book a satisfactory introductory study, even if they should wish to later go deeper into the subject. The book is divided into twelve chapters, as follows: Aircraft Types; Lighter-than-Air Craft; Early Airplanes and General Design Considerations; Design and Construction of Aerofoils; Arrangement, Construction, and Bracing of Airplane Wings; Airplane Fuselage Construction; Airplane Power Plants; Airplane Propeller Construction and Action; Airplane Equilibrium and Control Principles; Uncrating, Setting Up, and Aligning Airplane; Inspecting Airplane before Flight; Standard Airplane Nomenclature.

NEW CATALOGUES AND CIRCULARS

Baldwin Locomotive Works, Philadelphia, Pa. Record No. 91, illustrating and describing Mallet articulated locomotives.

Gaylord W. Feaga Co., Cleveland, Ohio. Catalogue of industrial and commercial buildings, showing constructions erected by this company.

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill. Bulletin 34-W, illustrating and describing the "Giant" semi-diesel fuel oil engine.

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletin 1041-A describing and giving specifications for Type S crane switchboards for direct-current motors.

Esterline Co., Indianapolis, Ind. Circular descriptive of the Esterline Model "MS" portable graphic power factor meters and Esterline duplex indicating instruments.

Columbia Machine Tool Co., Hamilton, Ohio. Circular illustrating and describing Columbia heavy-pattern crank shapers made in four sizes—16, 20, 24, and 28 inches.

Fairbanks Co., Rome, Ga. Catalogue 845 giving dimensions and prices of Fairbanks trucks and accessories. Catalogue 835 of Fairbanks wheelbarrows and drag scrapers.

Detroit Stamping Co., 951 W. Fort St., Detroit, Mich. Circular giving latest price list of spacers for milling machine arbors and showing improvements that have recently been made.

Milliken Bros. Mfg. Co., Inc., Woolworth Bldg., New York City. Booklet entitled "Space and Speed in Steel Buildings," descriptive of the standardized truss unit system of building construction designed by this company.

Gisholt Machine Co., 1200 E. Washington Ave., Madison, Wis. Circular illustrating the Gisholt turret lathe made in sizes from 13- to 41-inch swing. The circular also shows examples of work done on these machines and gives data relating to each job, including dimensions and production time.

General Electric Co., Schenectady, New York. Calendar for 1919 giving the current month, the preceding, and the following month on each page, as well as views of General Electric products. Attention is called to the fact that in order to save paper both sides of the sheets have been utilized.

Link-Belt Co., 39th St., and Stewart Ave., Chicago, Ill. Catalogue 353 entitled "Economical Handling of Coal and Ashes and Reserve Coal Storage" illustrating and describing Link-Belt equipment for handling coal and ashes, and giving information on the economies that can be effected by proper handling.

Butterfield & Co., Inc., Derby Line, Vt. Catalogue 17, covering the complete line of taps, dies, screw-plates, and reamers made by this company. The catalogue gives tables of dimensions and price lists, and includes a section giving tables of general information such as data on screw threads of various forms, pipe threads, machine screws, tap drill sizes, decimal equivalents, etc.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Cleveland handbook No. 6, describing this company's line of standard small tools, including couplings, sleeves, punches, dies, rivet sets, pistons, chisel blanks, wrenches, etc. In addition to the standard tools shown, the company manufactures special tools, and the catalogue reproduces specification sheets for use in ordering standard or special tools.

Carnegie Steel Co., Pittsburg, Pa. Bulletin treating of a new line of electric tool steels made in five grades, which this company is now marketing. The bulletin discusses qualities of steel, heat-treatment methods, heat-treatment temperatures, and the uses for which each grade of steel is especially adapted, and presents tables of weights of flat rolled steel, square, round, hexagon, and octagon bars.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Diary for 1919, containing, in addition to the calendar and diary sections, a considerable amount of useful technical and general information, including information on belting, electrical information, locomotive data, pulley and gear data, and turbine and condenser information, weights and measures, etc. The diary is durably bound and of a size that will slip in the vest pocket.

Union Tool Chest Co., Inc., 10 Railroad St., Rochester, N. Y. A folder in the form of a letter addressed to manufacturers in general, discussing the American workmen's task in the reconstruction period. Attention is called to the fact that great industrial activity will be necessary in order to accomplish the work of reconstruction, and it is believed that prosperity is certain to ensue. On the inside sheet of the circular are illustrations of Union tool chests, letters of recommendation of these chests, and reproductions of advertisements that have appeared in various trade journals.

Gisholt Machine Co., 1200 E. Washington Ave., Madison, Wis. Catalogue entitled "Gisholt Standard Turret Lathes," illustrating and describing the complete line of turret lathes manufactured by the company, together with standard equipment. The catalogue also shows a great many tool set-ups and examples of work that can be rapidly and economically performed on Gisholt machines. Many of the photographs are taken in the shops of customers, showing the actual work performed in other plants. The descriptive matter is clear and definite. Illustrated descriptions are included of standard chucking tools, boring and turning tools, facing heads and accessories, bar tools, tool-holders, cross-slide toolposts, chuck bushings, boring-bars, reamers, chucks, etc. A description of the turret gap lathe is also included.

TRADE NOTES

Duplex Machinery Co. Cleveland, Ohio, has moved from the Leader-News Bldg., to larger quarters at 1224 W. 6th St.

American Machinery Syndicate has removed its offices to larger quarters in the Commercial Engineers Bldg., 35-37 W. 39th St., New York City.

Hubbard Co., Pittsburg, Pa., announces that its stamping department, which was destroyed by fire last August, is now operating at Niles, Ohio, under the name of Hubbard Pressed Steel Co. The company states that all orders will be attended to immediately and that it is now in a position to take up new business.

Brown Hoisting Machinery Co., Cleveland, Ohio, announces the following changes in its organization: Harvey H. Brown, chairman of the board of directors; Alexander C. Brown, president; Melvin Pattison, vice-president, general manager and director; Robert G. Clapp, director; John F. Price, director; and Ewen C. Pierce, general manager of sales.

Hess Steel Corporation, Baltimore, Md., has established a branch office in Philadelphia, Pa., at 517 Widener Bldg., under the charge of Charles O. Rowe, district representative. A branch office has also been established at 50 Church St., New York City, in charge of Daniel V. Foster, who has been representing the Hess Steel Corporation in that district.

Skelton Sales Co. has made application to have the corporation name changed to the Skelton Tool Co. and the capital stock increased to $100,000. This company has purchased the plant of the Will & Baumer Co. at 406 Ash St., Syracuse, N. Y., and has begun equipping it for the manufacture of small tools. A complete hardening and heat-treating plant together with electric welding outfit will be installed immediately, and the Charles E. Skelton machine shop which has been absorbed by this company will be moved to the new location about February 1.

Independent Pneumatic Tool Co., Chicago, Ill., manufacturer of pneumatic drills, hammers and appliances, electric tools, motorcycles, and gasoline engines, announces the opening of a branch office and service station at 1103 Citizens Building, Cleveland, Ohio, on December 15. A complete line of "Thor" pneumatic and electric tools and repair parts will be carried in stock at this address. The new office will be in charge of Hayden F. White, who has represented the Independent Pneumatic Tool Co. in the Detroit, Chicago, and Milwaukee districts for some years past.

Taylor Welder Co., Warren, Ohio, maker of electric welders, will place on the market an electric arc welding outfit using alternating current. A close regulation of the current will be accomplished by means of controllers which will enable the operator to adjust the current to suit any condition which might arise in connection with work within the range of the full capacity for which it is intended to be used. The size of the outfit is reduced to a minimum which will make it easily transferred from place to place. The uses to which outfits of this kind are put is in connection with steel plate work such as will be found in shipyards, boiler shops, and the like, and they are also suitable for repairing defective castings in foundries and repair work of a general nature.

Polytechnic Institute of Brooklyn, Brooklyn, N. Y., is just starting a new course in tool drafting and tool design, to be given in the evening department of the institute. The class is open to men having considerable knowledge of mechanical drawing and modern machine shop practice. It aims to present to the student a knowledge of the essentials and fundamental principles involved in the design of tools and fixtures for interchangeable mass production. In the course, these principles will be arranged in a logical order with reference to their application, in order to give draftsmen and others in the tool-designing departments of manufacturing establishments a clear conception of the relation of essentials and principles that will enable them to more efficiently do work of this kind. Two other evening courses will also be started at about the same time—one in the theory of aeronautical engineering and one in marine engineering.